POPULAR SCIENCE

MONTHLY

OUR NAVY IN THE AIR —ITS COMBAT PLANES AND WHAT THEY CAN DO

pg. 68

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How U.S. Soldiers Invade from the Sea pg.

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POPULAR SCIENCE

FOUNDED 1872 MONTHLY VOL. 142 NO. 2

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

CONTENTS for FEBRUARY, 1943

News

Automobiles

Home and Workshop

Departments

(Contents continued on page 4)

MASTER DIE for the "heads" side of a Jefferson nickel. From this is made the working die which, with a similar die for the "tails" side, stamps the coins out of metal. Incidentally, nickels aren't nickel any more. That metal has more important work to do than feeding juke boxes. Your new five-cent piece is composed of silver, copper, and manganese. An article on page 84 tells how nickels are made.

Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Vice-Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A.

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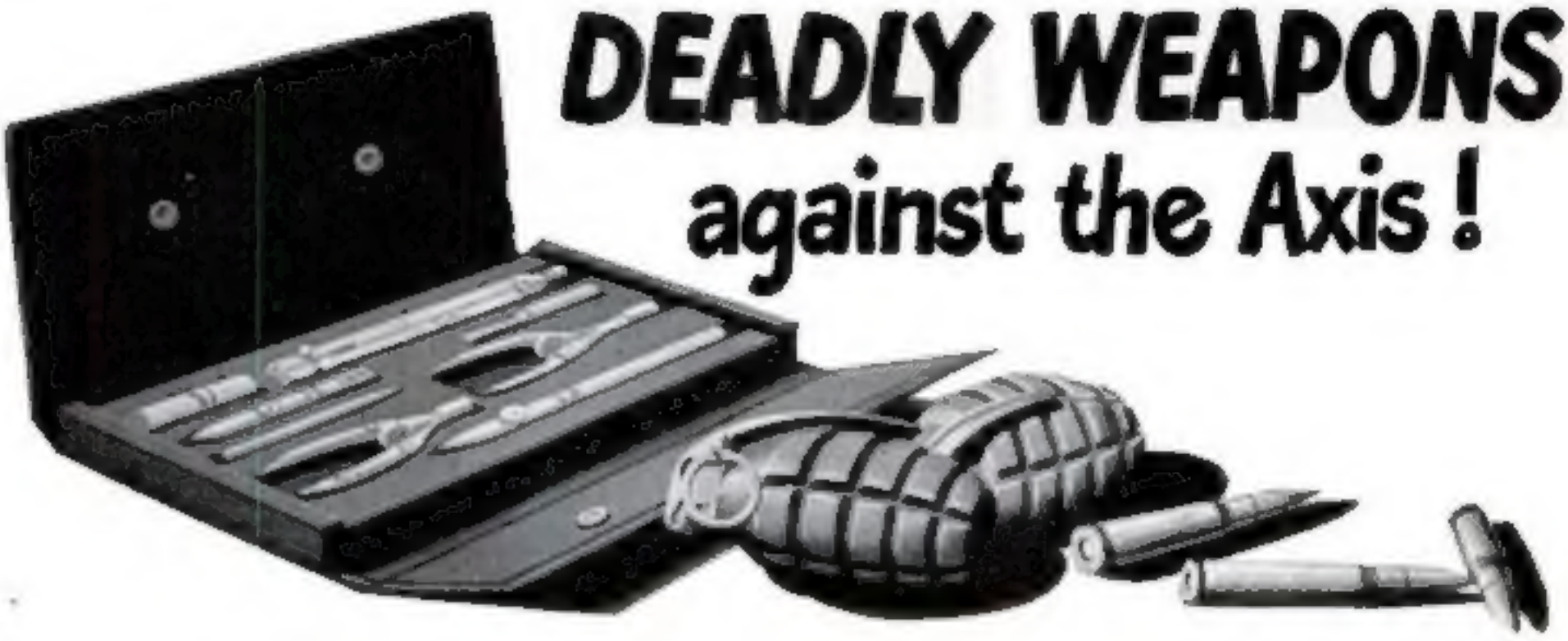
DEADLY WEAPONS against the Axis!



JUST as deadly—just as victory-vital—as planes, guns and tanks—are the *draftsman's tools!*

Without those tools—in *trained* hands—we'd produce no new planes, guns, ships, tanks, buildings!

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Mail this coupon, and learn how a low-cost I. C. S. Course in Drafting, studied in your spare time, can make you a better fighter on today's industrial battlefield—ready for a bigger, better paying job in the victory-world of tomorrow!

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City..... State..... Present Position.....

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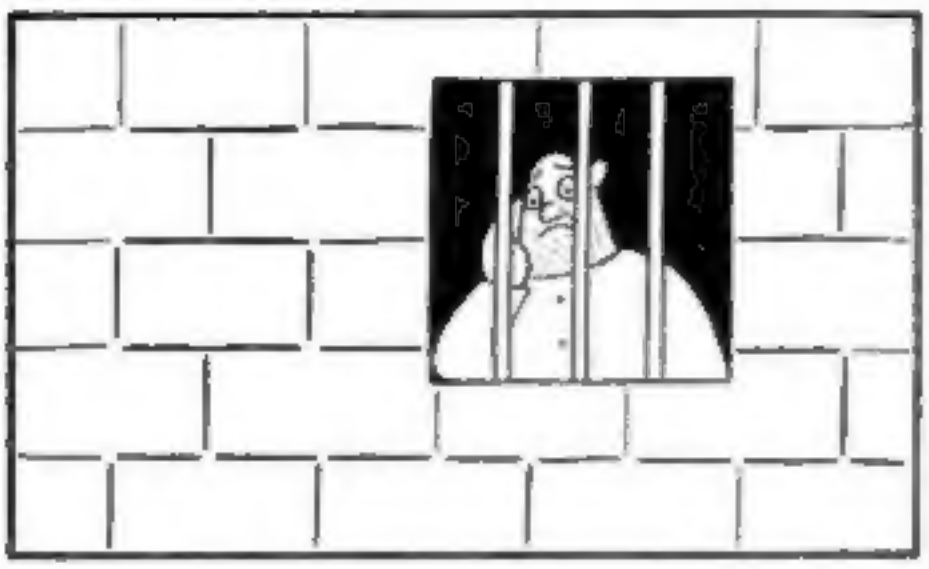

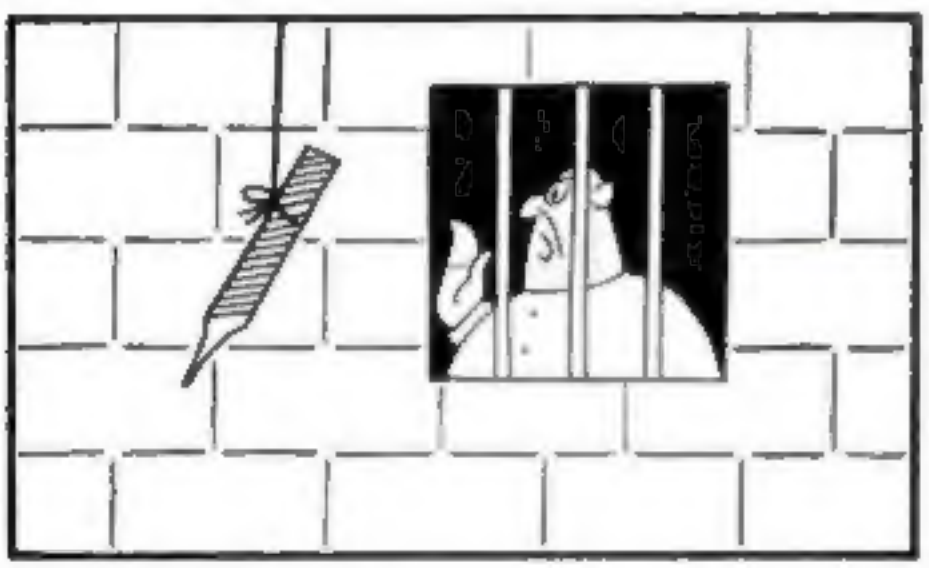

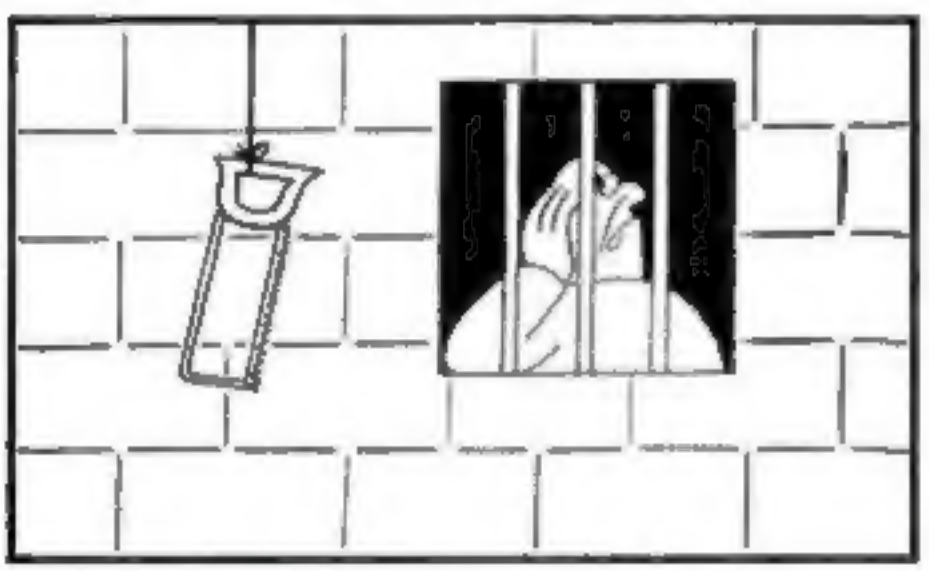

Contents [CONTINUED]

Automobiles

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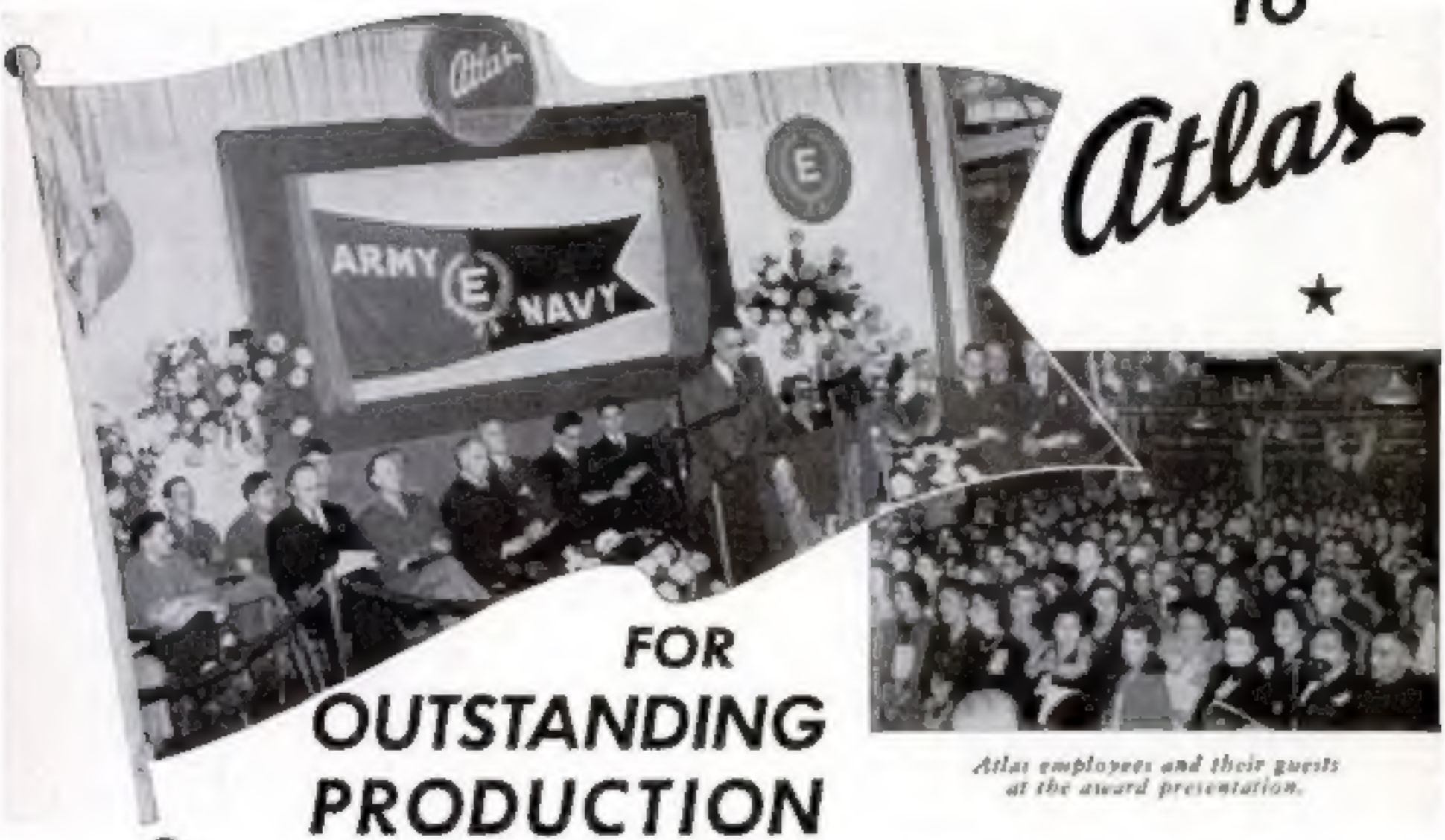
ARMY-NAVY "E" AWARD

TO

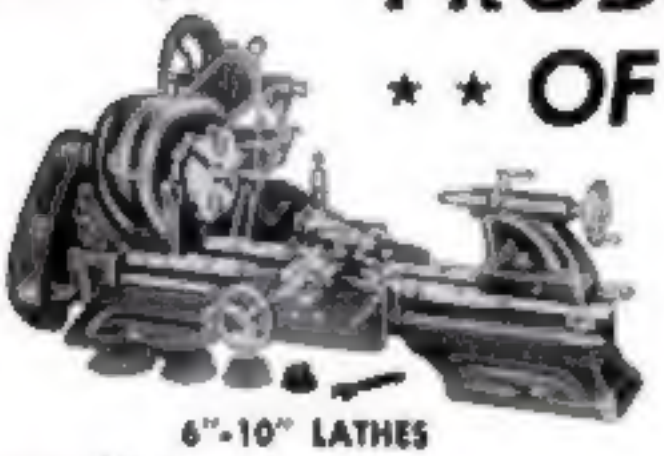
Atlas ★



Atlas employees and their guests at the award presentation.

FOR OUTSTANDING PRODUCTION

★ ★ OF THESE VITAL WAR TOOLS



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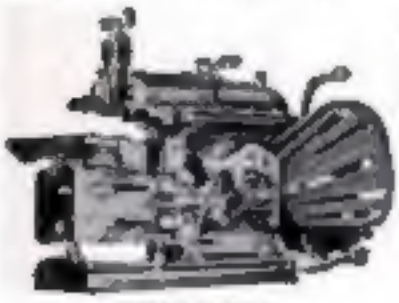

SHAPERS

THE men and women of Atlas proudly wear the Army-Navy "E" today. Over them fly two flags — Old Glory and the official pennant for excellence in war production. The "E" indicates high performance standards, but you can bet everyone in this organization is working hard to make the Atlas record even better. It's our part of the big job of licking Hitler and Hirohito!

This "excellence in production" means excellence in quality as well as quantity. Atlas Lathes, Milling Machines, Shapers, and Drill Presses have proved themselves thousands of times in war plants — and under the tough operating conditions of the Army and Navy mobile maintenance forces. Make a note of that in your "Want List" for the time when Atlas Equipment will again be available for non-war use. Atlas Press Company, 255 North Pitcher Street, Kalamazoo, Michigan.

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VICTORY FIRST! - THEN Atlas TOOLS FOR YOU

Craftwork

Electrical

Home Building

Miscellaneous

(Continued on page 10)

WHITE COLLAR or OVERALLS—

Which will YOU wear after the war?

HUNDREDS of thousands of white collar workers have put on war overalls for the duration. Millions of both white collar and overall workers have put on uniforms. Hosts of home women are patriotically taking jobs.

After the war, millions will be coming back from army, navy and air force to civilian jobs; great war materials factories will be re-converting to civilian production; old peace-time functions of business will be springing up—where will you fit in the situation?

If you are wise, you will look ahead and prepare. You will not wait on chance. You will analyze the probable conditions in peace employment, decide where your likes and aptitudes fit best, and get ready. You will decide whether your best opportunities lie in production or office or store. You will determine whether you wish to work for someone else or develop a business of your own. You will train now to be above the average and, therefore, surer to get the opportunity you want after the armistice.

Nor will you wait very long. Nobody knows when this war will end or how soon this problem will hit you in the face.

We Can Help You Decide

If you have some question either about postwar opportunities or about your own fitness for some particular one, probably we can help you. In our 34 years, over one million adults have enrolled for our training, we have built training courses for many major fields of commerce and industry, and we have gathered a wealth of information about job opportunities and requirements. That information is at your service.

We Can Help You Prepare

And when you have decided what field of work offers most to you for a life career, we can help you prepare for it—quickly, economically, thoroughly, in your spare time and without any interference with your present work—if it is in the list below. A 48-page booklet on the field of your choice, discussing the field and our training for it, has been prepared to help answer your questions. The coupon below or your letter will bring it to you, without cost or obligation.

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- ☐ Business English
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- ☐ Accounting
- ☐ Law: LL.B. Degree
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Present Job.....

Address.....

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Men I Train Win Success Like This

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"I have been regularly employed in Radio since my graduation. I have been Chief Engineer of three broadcast stations, and at present time am Chief Engineer of WDOD. My salary has increased $1,800 per year since entering Radio and credit is given you for your excellent training." JULIUS C. VESSELS, Station WDOD, Chattanooga, Tenn.

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"For several years I have been in business for myself making around $200 a month. Business has steadily increased. I have N.R.I. to thank for my start in this field." ARLIE J. FROEHNER, 300 W. Texas Ave., Goose Creek, Texas.

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Here's your opportunity to get a good job in a busy wartime field with a bright peacetime future! There is a shortage today of trained Radio Technicians and Operators. If you're in a rut, worried because your present job offers no chance to get ahead—find out about RADIO!

Mail the Coupon for the FREE Lesson from my Radio Course described below. It shows you why N.R.I. training offers **a quick way to more pay.** And with this Lesson I will send you FREE my 64-page, illustrated book, RICH REWARDS IN RADIO. It describes many fascinating types of Radio jobs, tells how N.R.I. trains you at home in spare time, explains the unique training method which I have developed and perfected during my 28 years of teaching Radio by mail.

ACT NOW! Many Beginners Quickly Earn $5, $10 a Week Extra in Spare Time

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Right now, probably in your neighborhood, there's room for more spare and full time Radio Technicians. The Radio repair business is booming, because no new Radios are being made. Many Radio Technicians are starting their own FULL time Radio businesses . . . making $30, $40, $50 a week.

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How to remove tubes, tube shields
Three reasons why radio tubes fail
Electrodynamic loudspeaker:
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  Replacing damaged cone
  Recentering voice coil
  Remedies for open field coil
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Gang tuning condensers:
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  How capacity varies
  Restringing dial cord
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How condensers become shorted, leaky

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Isolating defective stage
Locating defective part

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MAIL THE COUPON. I'll send you the FREE Lesson and my 64-page illustrated book, RICH REWARDS IN RADIO. They're packed with Radio facts, things you never knew about opportunities in Broadcasting, Radio Servicing, Manufacturing, other Radio fields.

You'll read a description of my Course—Extra Money Job Sheets—Consultation Service—other special N R I. training features. You'll see the fascinating jobs Radio offers and how to learn Radio at home. You'll read many letters from men I trained telling what they are doing, earning. And you'll have my FREE LESSON to keep. No obligation. Just MAIL THE COUPON.—**J. E. SMITH, President, National Radio Institute, Dept. 3BP3, Washington, D. C.**

Broadcasting Stations employ N R I. trained Radio Technicians as operators, installation, maintenance men and in other capacities and pay well.

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Age.....

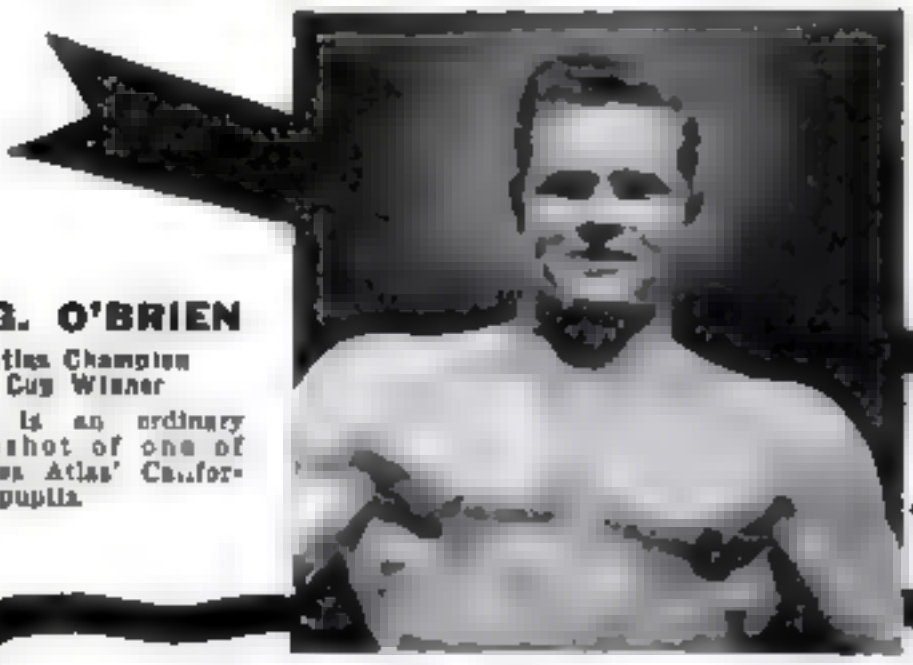
Name.....

Address.....

City.....State.....

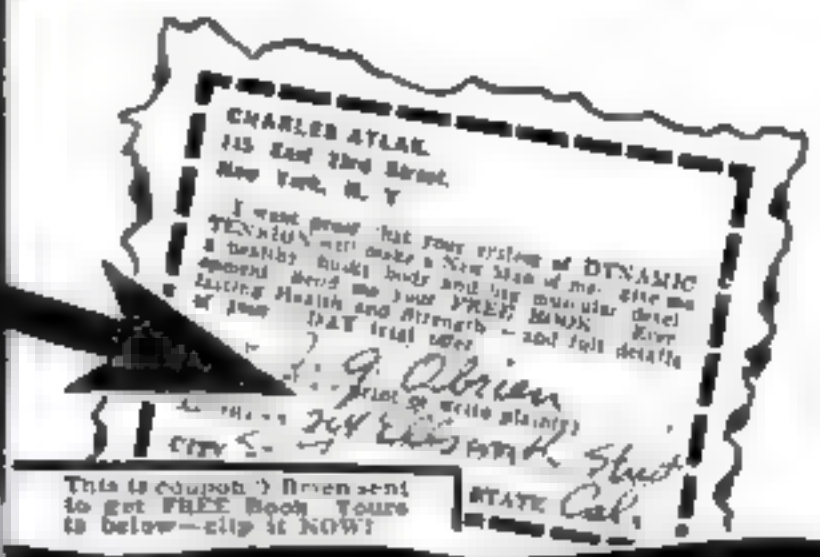
4FR-2

HE Mailed This Coupon

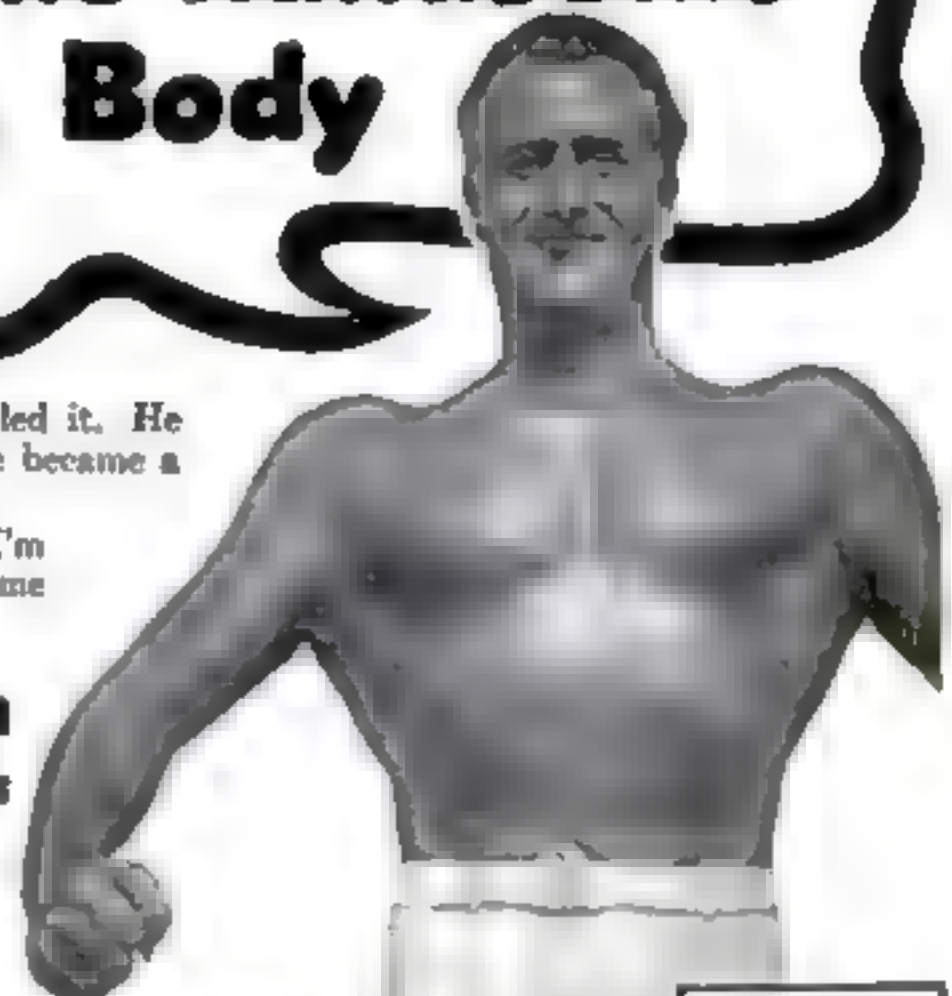


J. G. O'BRIEN
Atlas Champion Cup Winner

This is an ordinary snapshot of one of Charles Atlas' Californian pupils.



...and Here's the Handsome Prize-Winning Body I Gave Him!



J. G. O'BRIEN saw my coupon. He clipped and mailed it. He got my free book and followed my instructions. He became a New Man. NOW read what he says:

> "Look at me NOW! '*Dynamic Tension*' WORKS! I'm proud of the natural, easy way you have made me an 'Atlas Champion'!"
>
> *J. G. O'Brien.*

"I'll prove that YOU, too, can be a NEW MAN"—*Charles Atlas*

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Only 15 Minutes a Day

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CHARLES ATLAS

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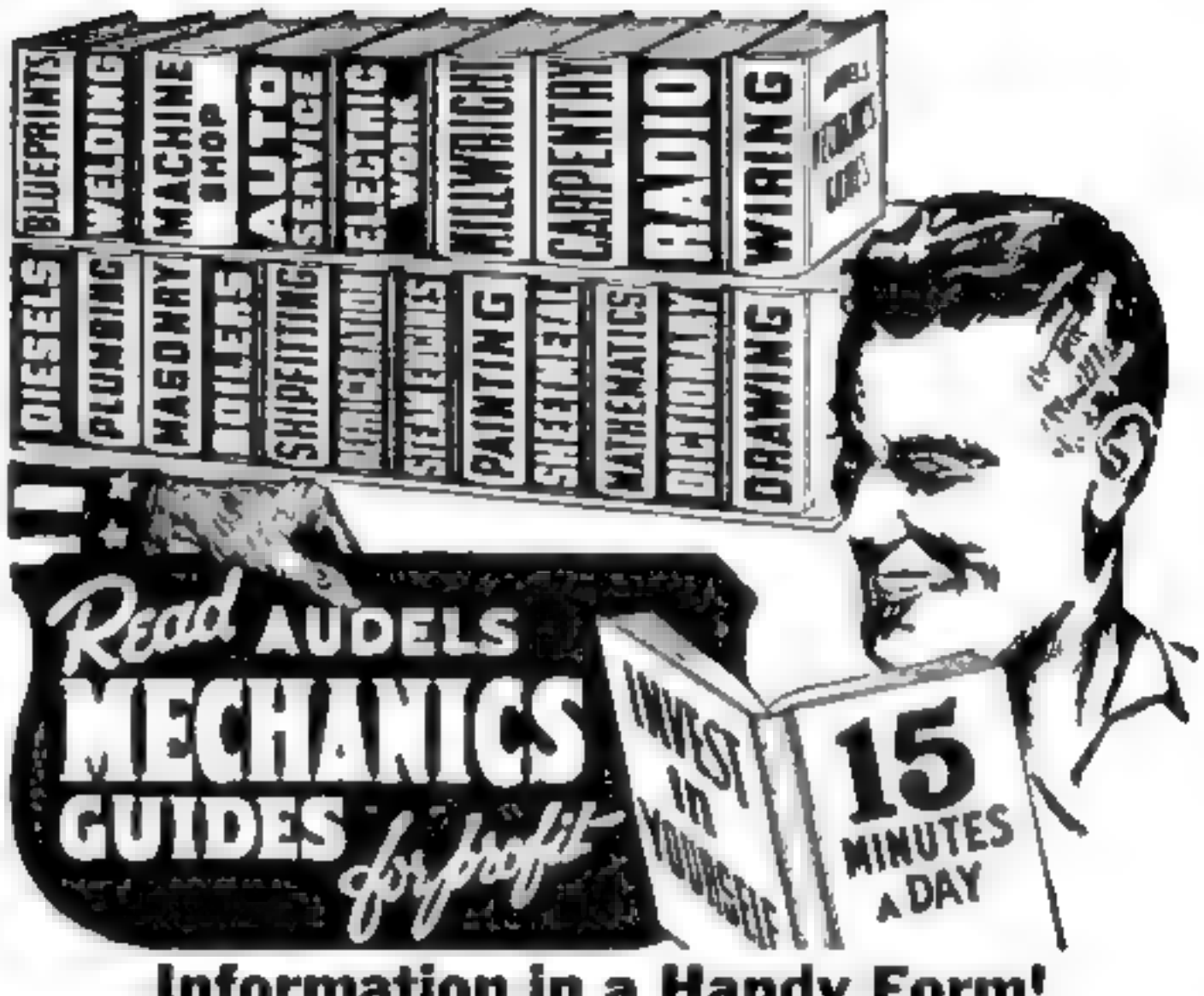

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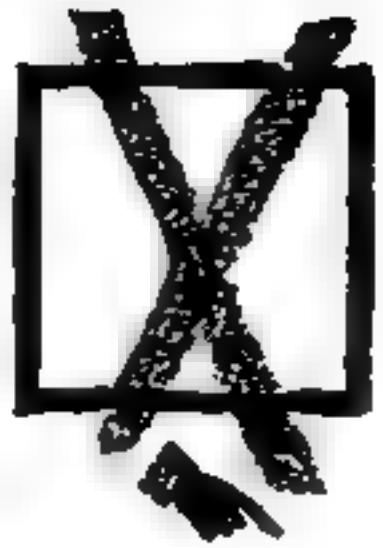

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by C. S. (Casey) Jones

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C. S. JONES

An architect drafting aircraft parts...a real estate salesman at a lathe...a housewife operating a drill...all over the country men and women are learning new skills, finding new interest and usefulness in the industry which is of first importance in winning the war.

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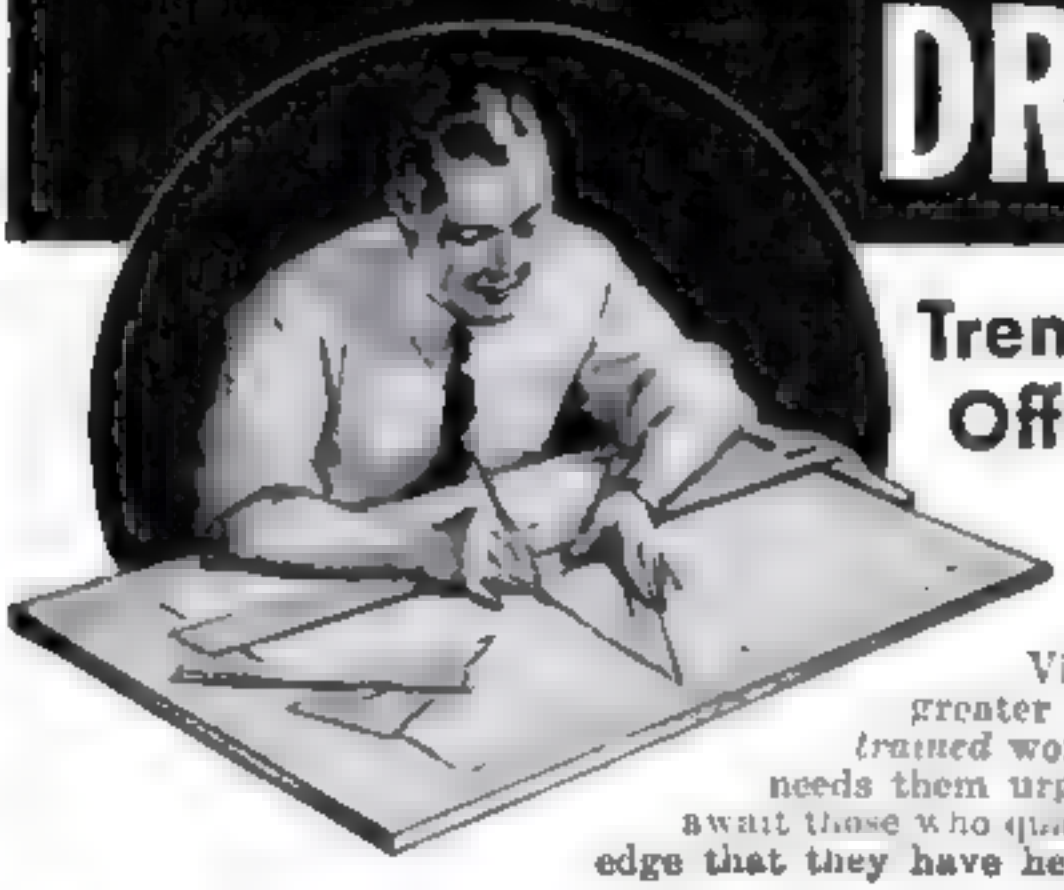

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Readers Say:

He's Long on Ideas For Filling Shortages

HAVE been a reader of P. S. M. from the beginning, and have hundreds of copies stored away in my workshop where, from time to time, I get them out and get a lot of good from them. Got no kick coming the way you handle your magazine, only seems of late a little too much on the fighting front and a little slack on the home front. Us fellows too old to get into the scrap are having our troubles too. Why not more kinks to help us out while there is a shortage of everything? For instance, I needed an alarm clock. Plenty of money to buy one, but not a one in this city of over a hundred thousand population. However, I gathered an old one—thrown away in the days of plenty. Soaked the works in a pint of gasoline and a tablespoon of three-in-one oil. Result: clock, thoroughly cleaned and oiled, runs like nobody's business. I like sugar and plenty of it in my coffee. But what—can't have as much as I want. No kicking, however. Just took some corn sirup, added some honey, boiled it like making old-fashioned taffy, pulled it the same as taffy. Boy, it sure sweetens coffee to a "t." Don't need my ration card any more. But with coffee rationing, what's the good of sweetening? Nothing to get excited over, however. Just took some nice clean field corn, browned it almost black in a skillet, ground it in a coffee grinder, then mixed it three parts to one part of coffee. Got more coffee now than I ever had.—A. H. W., Phoenix, Ariz.

Film Rental Library Furnishes W.P.B. Movies Free

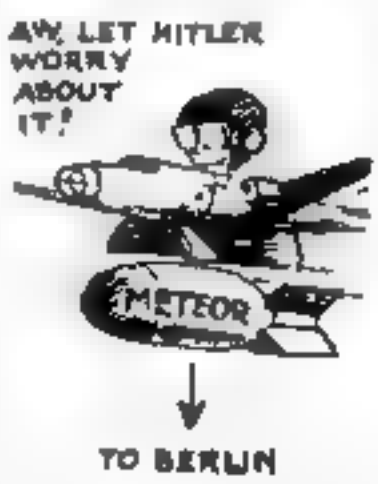
HERE in Dayton we have a film rental library which offers, free of charge, a set of seven War Production Board films dealing with such interesting subjects as women in defense, the building of bombers and tanks, and the producing of aluminum. I am writing to tell you about it because it seems to me it would be a good idea if this service could be given throughout the country. I feel sure that those of your readers who have projection machines would be happy to have such a service in their vicinity. Each of the seven reels offered by the Dayton Film Rental Library is a 16-mm. sound film which runs between 15 and 20 minutes, and, in addition to the main WPB subject, contains a short subject and a rendition of "The Star Spangled Banner." Such stars as Katharine Hepburn, Fredric March, and Orson Welles act as commentators, and music is furnished by Jan Peerce and Conrad Thibault. The only expense incurred in using these films is the express charge to and from the library. It is understood, of course, that no admission is to be charged in connection with the showing of these films.—R. F. P., Dayton, Ohio.

P. S. M. and Grandpa Start Young Scientist Off on a Career

FOR THREE successive years my Christmas gift to a grandson has been a subscription to your magazine. He is now almost 15 years old, and a freshman at high school. You may be interested in the following from a letter he has written me: "In a previous letter I told you that I enjoyed P.S.M. Well, I never realized how much I received from it. The teacher at high school who teaches general science told Dad that I had the best scientific background of any student he has had for years, and that if I keep going at the rate I am going now, I have a promising future in science. I think that is a pretty nice compliment. I have to thank you for it all because P. S. M. is the only science magazine I ever read."—J. J. T., Fresno, Cal.

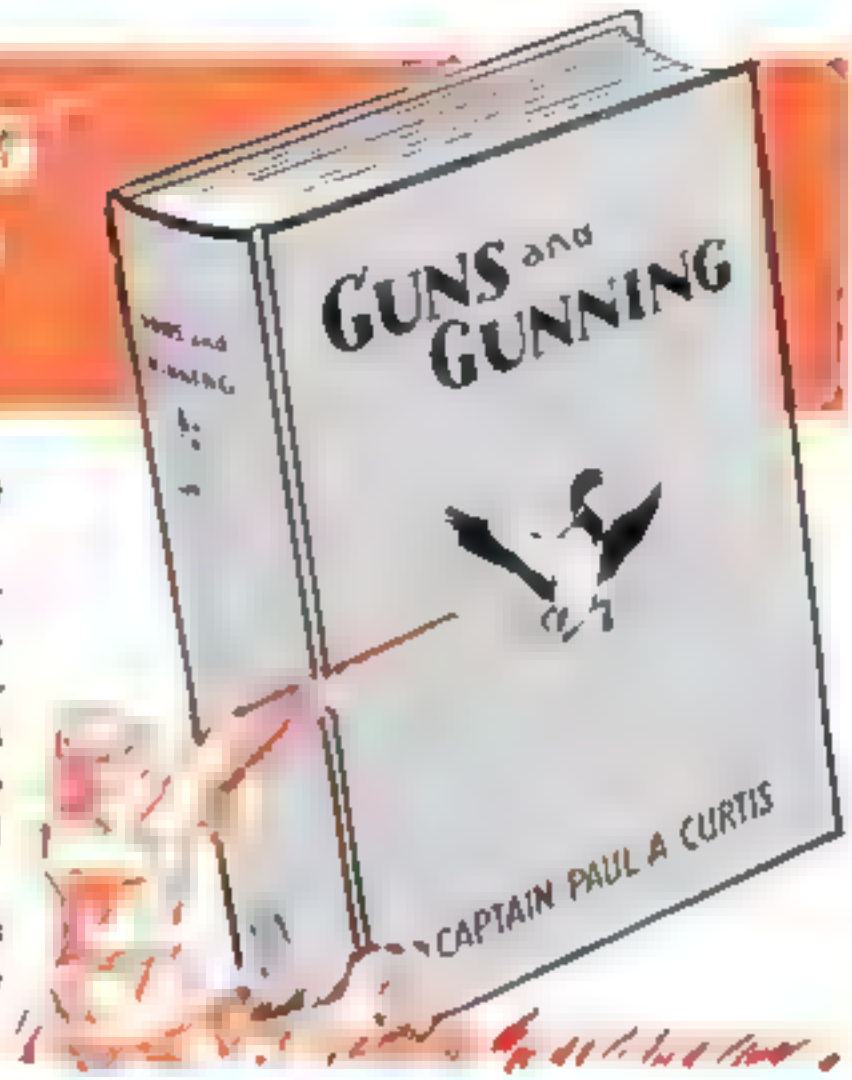
Start Running Now, Fellows, and We Won't Get Hit

HAVING just read the December issue of your grand magazine, I would greatly appreciate it if some one of your more scientific readers would tell me exactly where G. H. F. C.'s meteor, which is due to hit the earth violently, will land. I am asking this so that I can be some place else at the time. I also understand the collision will cause a change in the climate. May I have some details on this too so that I can buy the right kind of clothes?—G. H. S., New York, N. Y.



BOOK BARGAINS FOR SPORTSMEN

GUNS — GUNNING



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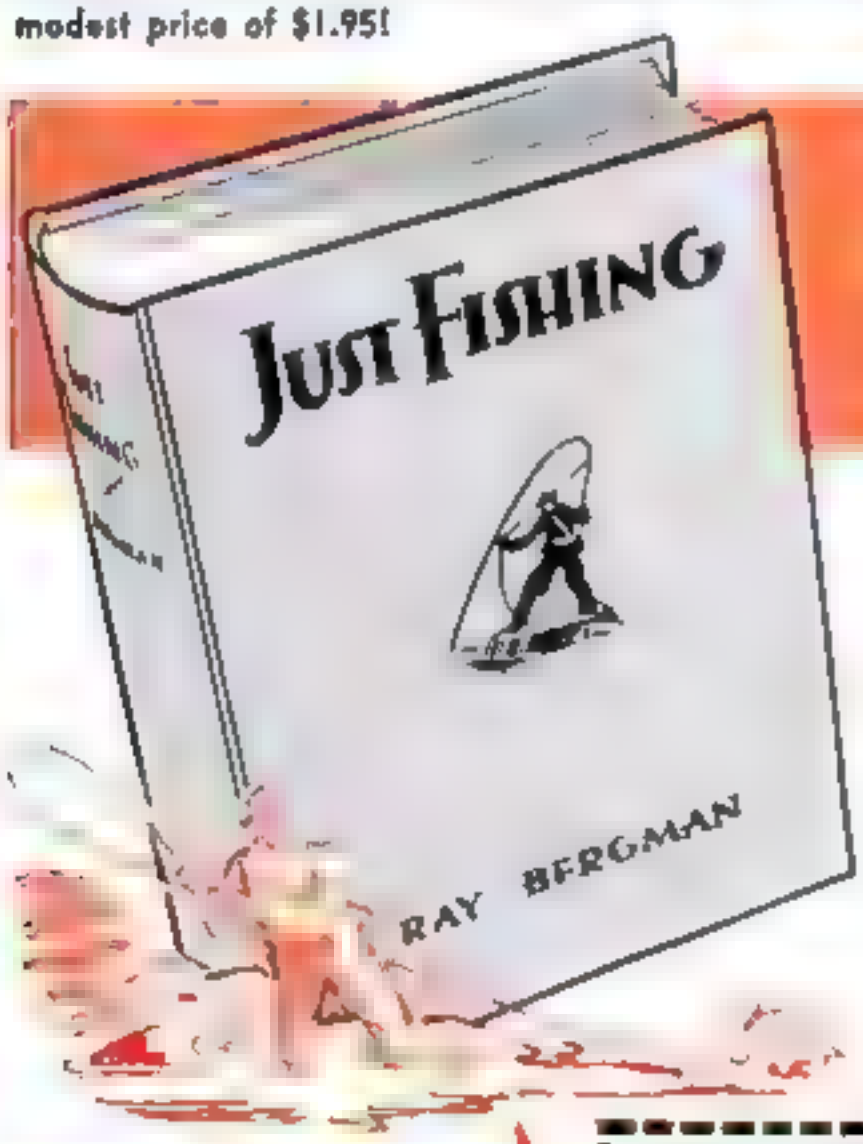

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Readers Say:

Ask the Commando Who Has Swum One

HERE'S a brain teaser which I think might interest your readers. A man jumps into a river and starts swimming at the rate of two miles an hour toward a pier which is directly opposite him on the other shore. If the river is 100 yards wide, and is flowing at the rate of one mile an hour, how long will it take the man to reach the pier, assuming, of course, that in swimming he always aims directly at the pier?—C. J. Peoria, Ill

Maybe the Hard Way Is the Easy Way After All

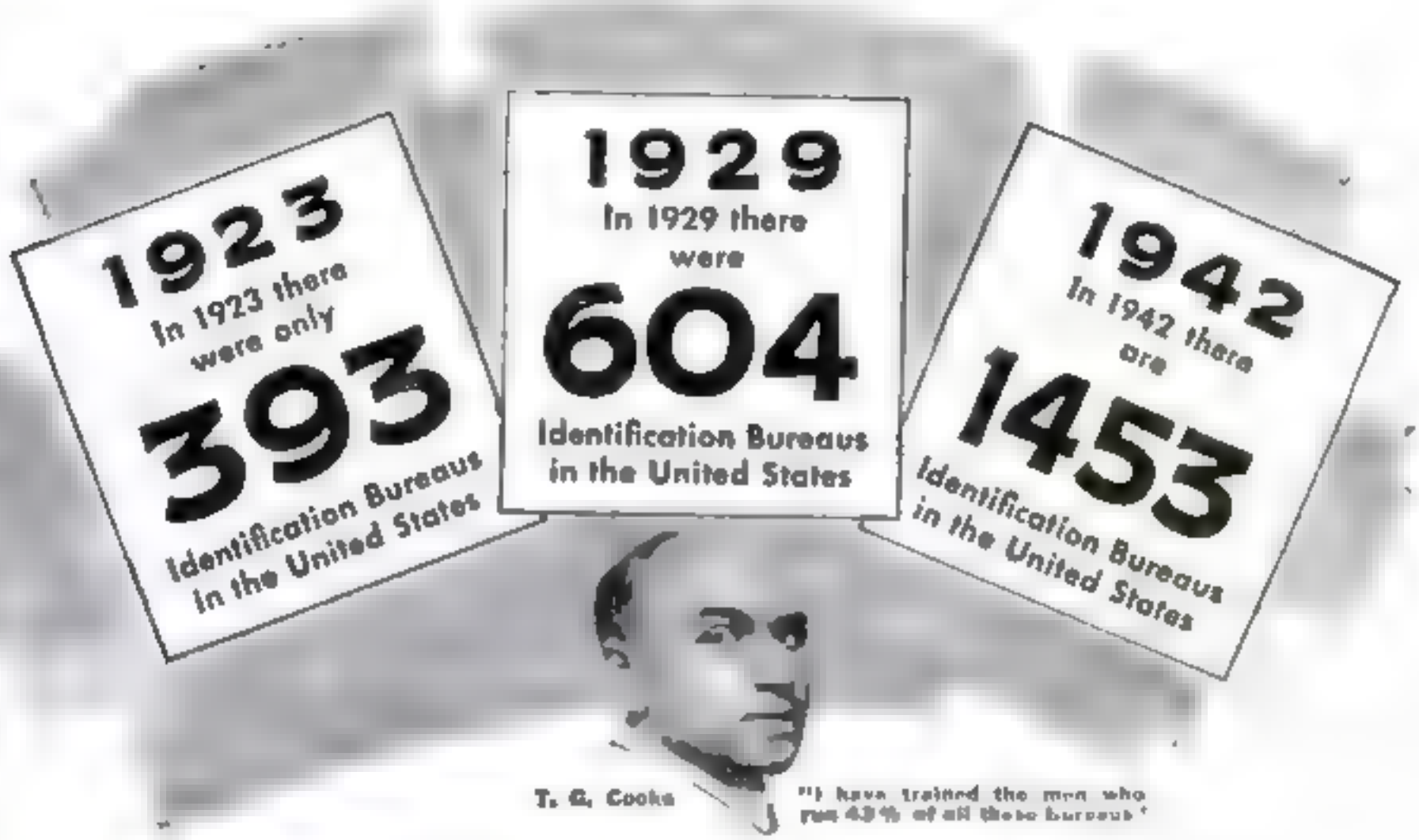
WHERE did R. D. H., in the November issue, get the idea that it would be difficult to solve his problem of packing balls into a box? It's about the simplest problem I know of. Since the box is 10 inches long, and the balls are each one inch in diameter, there will be ten balls in each row. The box being 10 inches wide, there will be 10 rows, making 100 balls in each layer. His box is also five inches high. Therefore there will be five layers. Five layers of 100 balls each will make 500 balls—the answer he is looking for. If he doesn't believe this, tell him he can buy 500 one-inch balls, try out the problem with a box of the right size, and see for himself.—D. L. C., Williamsport, Pa.

Things Look Black All Over, Don't They, Mr. Shickelgruber?

THE prophecies and predictions of Doctor Michel Nostradamus of the 16th century will afford you interesting study. It seems that some great explosion is expected between the fall of 1942 and the late spring of 1943. An ice age is also predicted for Europe, as well as the final destruction of Japan. It is a well known geological fact that before the former ice age, North America was practically a semitropical paradise. Should the prophecies for Europe and Japan come true, North America might very easily again become a land of warmth and sunshine.—MRS. E. V. P., Detroit, Mich.

New Jobs! More Jobs!
FINGER PRINTING IS GROWING FAST

Look What's Happening!



. . . And Now Defense Work Demands Still MORE Experts

If it's quick action you want—good pay NOW and BETTER pay later—if it's steady work you want, whether times are bad or good war time—peace time, any time—become a Finger Print Expert. City, county, state and federal need for men of this exclusive profession is constantly increasing! See for yourself how many more Identification Bureaus there are now than there were just a few years ago.

You Can Learn Quickly

Finger Printing is easy to learn. But it isn't something anybody can do expertly without training. That protects you. It IS learned rapidly. Not much time is needed. You can begin right now and qualify as a Finger Print Operator almost before you know it, and once you've graduated, you'll have something no one can ever take from you—a profession for the rest of your life!

Here Are the Facts

Forget the Defense urgency—forget all the new finger printing jobs opened by the war emergency. Just look at the regular normal growth and expansion of the finger printing profession. In 1923 there were 393 Identification Bureaus in the United States, as stated above. In 1926 it grew to 545. At the end of 1929 there were 604. At the close of 1937 there were 978, and at the beginning of 1942 there were 1453 official Identification Bureaus in this country and—**43% of these bureaus are run by graduates of the Institute of Applied Science.** Yes, 43%—almost half! We believe this to be a world's record.

The Cost of Training is Extremely Low

It's not like learning many other things . . . no long years of study—no heavy expenses. Learning to become a finger print expert costs you very little—so little you'll wish you'd started in this extremely important profession a long time ago. And you can get this training on the payment plan if you want to. Seize this chance—begin by mailing the coupon—get started—be through and ready in plenty of time to cash in on the opportunities in finger print work.

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This book takes you right on the inside of Scientific Crime Detection, tells you about finger printing, firearms identification, police photography and explains just how many types of crime are cleared up. It will be sent to you entirely free of charge. The coupon below brings it.

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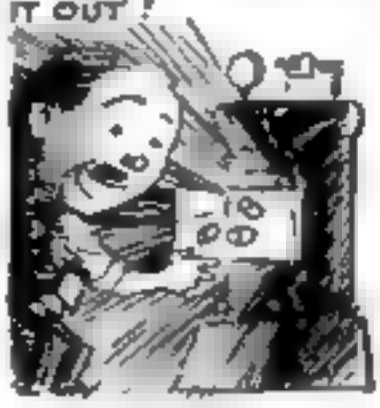
Readers Say:

Patriotism Burns Brightly Even With the Lights Out

I FIND that I have on hand about 50 used flashlight batteries. In these days when it is both uneconomical and unpatriotic to throw anything away, I am wondering if any of your readers know of a way in which I can still put these batteries to some good use.—S. G. Philadelphia, Pa.



At first glance, our artist's suggestion may seem a bit on the wasteful side. But actually it isn't. The zinc casing of the cells will clean out the soot in the flues, and over a period of time, you'll find you are saving coal.—Ed.

So We Americans Are Just Softies, Eh?

IN YOUR December issue, I. K. says that radio bugs all over the country who are pretty handy with soldering irons and other tools are being left out of the war effort. He wants to know what can be done to let them contribute their equipment and knowledge toward winning the war. Well, you can add two more radio bugs to the list—one a lad with a bad heart and who can't go to school, the other a blind piano tuner. We have the necessary equipment. All we need now is for someone to show us how we can do our share.—R. D. B., Johnstown, Pa.

One of These Days Gus Is Going to Blow Up

IN READING, in the November issue, the Gus Wilson automobile story, "Trouble Comes Double," I noticed that Gus is smoking his pipe near his filling station. This I thought was against the law, as in every filling station I have ever been I have seen big signs saying "No Smoking Allowed." I just wanted to mention this to you because I think that smoking close to a gas pump is very dangerous.—H. O. W., Dallas, Tex.

Thanks, H. O. W., for calling it to our attention. Personally, we are all very fond of Gus, and we'd certainly feel badly if anything ever happened to him.—Ed.

HERE IS JUST A

PARTIAL LIST

of the Rare, Exhilarating and Hilarious

CONTENTS—

THE BACHELOR LIFE
by George Jean Nathan

It isn't true what they say about the gay bachelor. The trouble is to the contrary in that a bachelor is a man who thinks before he acts, and then doesn't act!

LIFE IN HOLLYWOOD
by Frank Sullivan

Six cry [illegible] screen sirens fall in love at first sight with amazing rapidity. Love in Hollywood is quite regular. And this is what makes for zest and adventure there.

JUST A FREUDY CAT
by Jack Henley

"Or Memoirs of a Freudian Nightmare" is the subject of this [illegible]. The author goes through a series of disasters that are shocking to the point of blushing. It is the dreams

THE PLAYBOY AT FIFTY
by Dr. Edwin F. Bowers

At fifty many of us don't have half the sense that God gave a chipmunk. We spend our energy as a drunken sailor on leave spends his hard won gold.

THE 99 44 100 % PURITANS
by Duncan Underhill

Marriage and the religious relations were [illegible] complicated [illegible] problem [illegible] connected with the problem of keeping warm in the long cold winters. Fur lining and bundling kept the Pilgrims warm and happy.

MR. PREBLE GETS RID OF HIS WIFE *by James Thurber*

How Mr. Preble accomplished his object like without benefit of lawyer, [illegible] or alimony. A Thurber at his very best.

STAG LINES
by William Allan Brooks

A repertoire of the latest jokes, [illegible] debits which will make you the life of the party. Try a few of them the next time you have pulled out and you will discover why the charming ladies always fall in love with a good story teller.

HAVE FUN WITH YOUR CLOTHES ON *by W. A. Brooks*

A challenge to the intrepid playboy to try some of these tricks on his stubborn friends.

ADVICE TO A YOUNG MAN ON THE CHOICE OF A MAIDEN
by Benjamin Franklin

Benjamin Franklin's masterpiece, considered the wittiest piece of writing of early America, for a long time hidden away in private archives, and only recently released for reading to the general public.

SONGS AND BALLADS,
A mellifluous miscellany.

Here is a cunning collection of virile verse, the kind that mother never taught me. Contains your old favorites and a choice lot of new ones. To every man with red blood in his veins comes a yearning sooner or later to stand up on his hind legs and sputter poetry. None of that sissy stuff but real poetry.

LIMERICKS ON PARADE
by Percy Bennett

Here is a selection of old and new limericks, lightly clothed in gay prints to [illegible] and here is a droll and cute work which [illegible] and you will agree that the best limericks are not necessarily unprintable.

THE GREEKS HAD A YEN FOR IT *by Gilbert Seldes*

They lived and loved in a very fashionable way. Ask your friend who studied Greek in college about the well established hetaeria and they did a lot right without benefit of etchings.

WIT AND WISDOM

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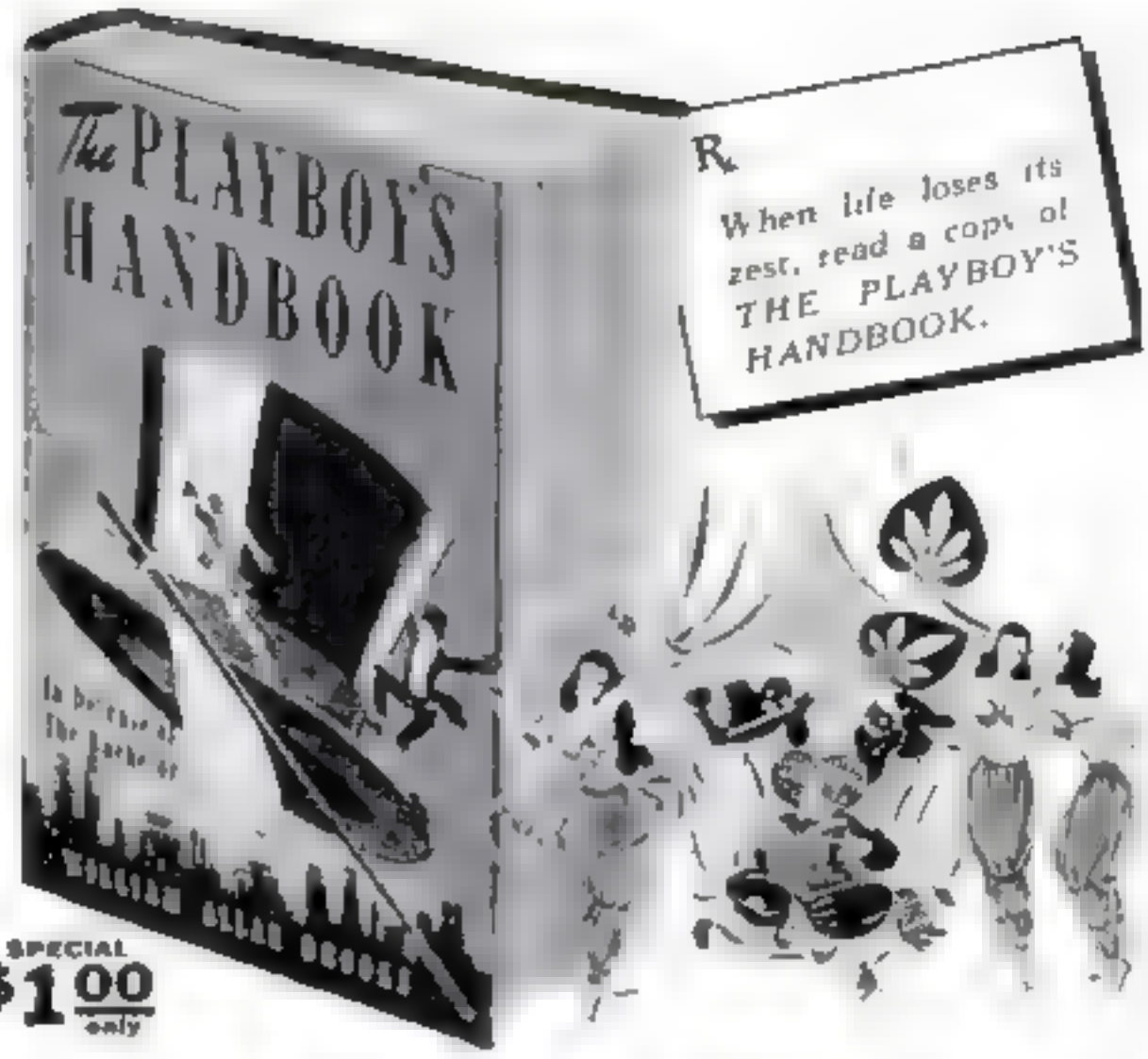

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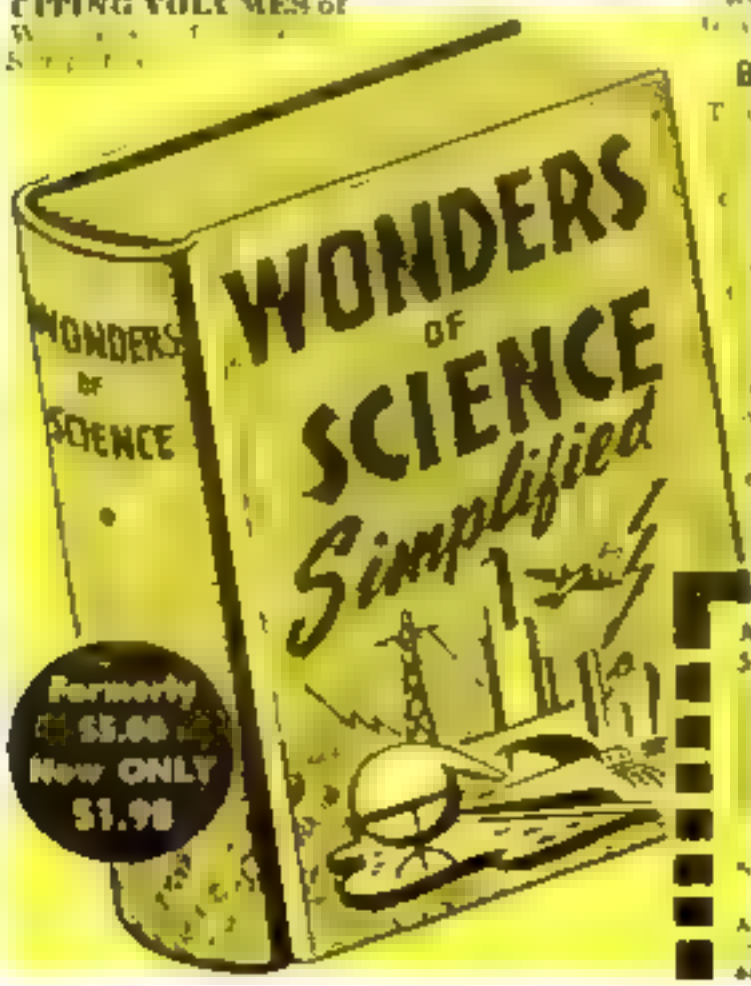

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From the News Editor's Desk

A RECENT SURVEY of the various types of physical defects which have made it necessary for draft boards to reject men for military service has brought to light some rather curious facts about our national health. In New England most rejections are due to bad teeth; in the Northwest to heart trouble; in the Great Lakes region to goiter; in Texas to blindness, and in the Gulf states and the Southeast to drug addiction and alcoholism. This geographical distribution of physical defects, however, is believed by Dr. H. L. Shapiro, anthropologist of the Museum of Natural History, to be caused as much by heredity as by local physical and social conditions.

THE DO-IT-BETTER PRINCIPLE which is now basic in every industry connected with the war, has now found its way into the building of side-launched ships. A whole row of these boats are built side by side, extending back from the edge of the water. Starting with the one farthest back, each ship is moved a step closer with each stage of production until, virtually completed, it topples off the end into the water. Besides speeding production, this assembly-line method has revealed the best angle of tilt for a ship, the right velocity for launching, and the proper degree of roll as it hits the water.

A NEW CHEMICAL PROCESS of reclaiming rubber, which will add considerably to the longevity of a recapped tire, has recently been announced by an eastern rubber company. Said to reduce the "cooking" time from 12 hours to 20 minutes, and to eliminate the heat and oxygen treatment which has the effect of destroying the tensile strength of reclaimed rubber, the new process promises mileages up to as high as 18,000 miles instead of the mere 10,000 now being obtained. Although the process is being kept secret from the general public, it is being made available to rubber-reclaiming companies for the duration without payment of royalties.

JOLLY GOOD FELLOWS whose mornings after are persistently blighted by a "hangover" and the fluttering of butterfly wings in the stomach, may find solace in the medical pronouncement that these deplorable conditions are not necessarily a retribution of overindulgence. The authority in question states that it is the biliary tract which is at fault when "reasonable amounts of alcohol produce ill effects." The good doctor, however, makes no estimate of what is a reasonable amount.

THROMBIN, A CLOTTING AGENT which the blood forms when it is being shed, can now be obtained in large quantities in sterilized form. The method of producing it has been developed by a professor of the Moscow University, and the agent is being used with outstanding success on wounded Russian soldiers. When mixed with blood, the new solution will clot it within three to five seconds.

INVENTORS AMERICA NEEDS YOUR IDEAS

In War and in Peace

Your country—in fact the whole civilized world—is in crying need of new ideas—these new ideas, YOUR IDEAS, must lead not only to victory in war but to prosperity in the peace which will inevitably follow. TIME MARCHES ON—today's inventions are tomorrow's craftsmanship, and post-war prosperity and readjustment will demand the creation of thousands of simple things that will win recognition—perhaps wealth—for you. TIME MARCHES ON and you march with it—or it passes you by.

Peace Is Coming

Factories now converted to War Production for the duration are already buying new inventions. They must take up **NEW IDEAS** in order to continue in business when the war ends. That's the time when new improved articles will be rushed onto the market and the lucky patent holders will reap the profits.

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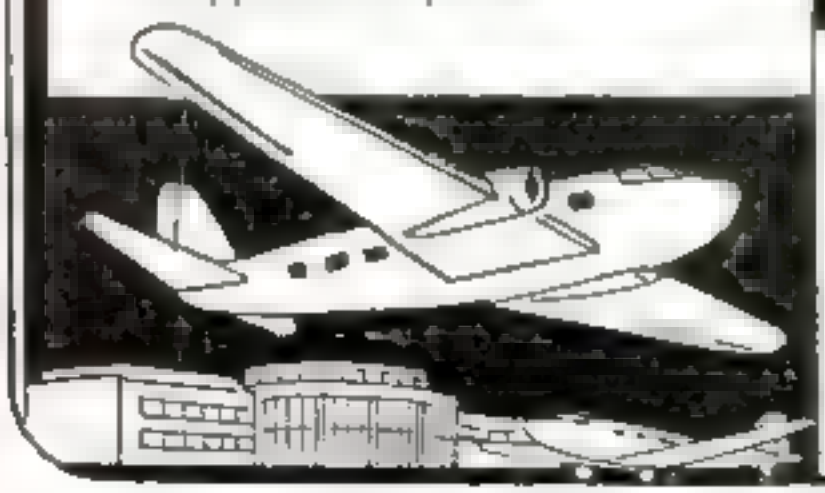

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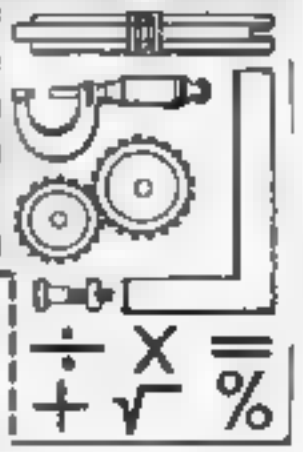

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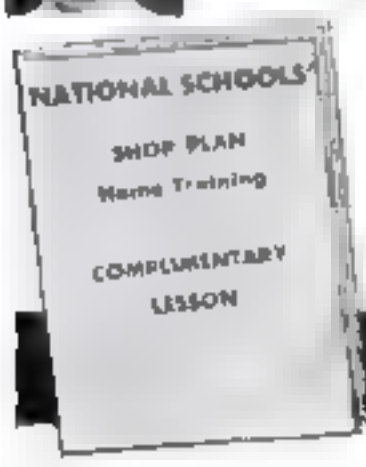

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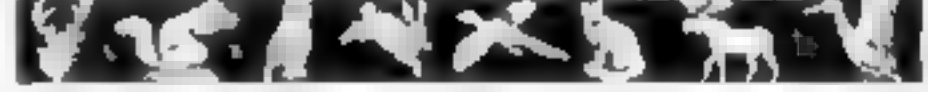

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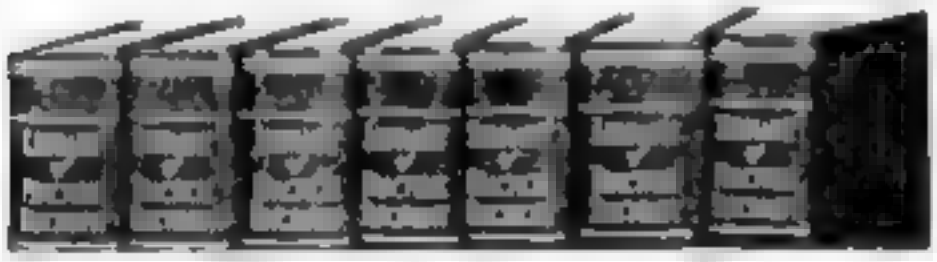

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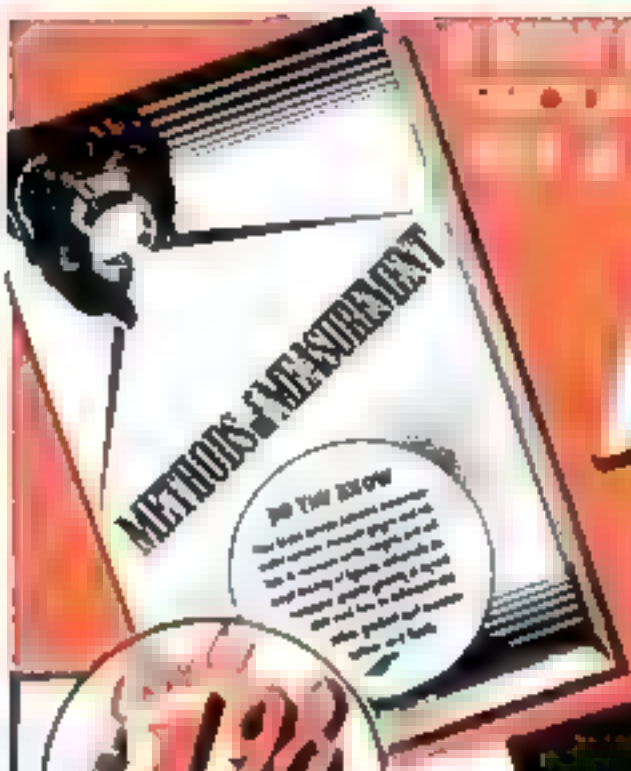

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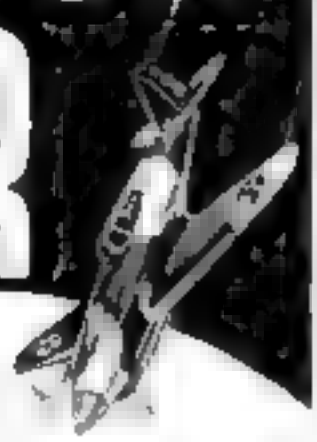

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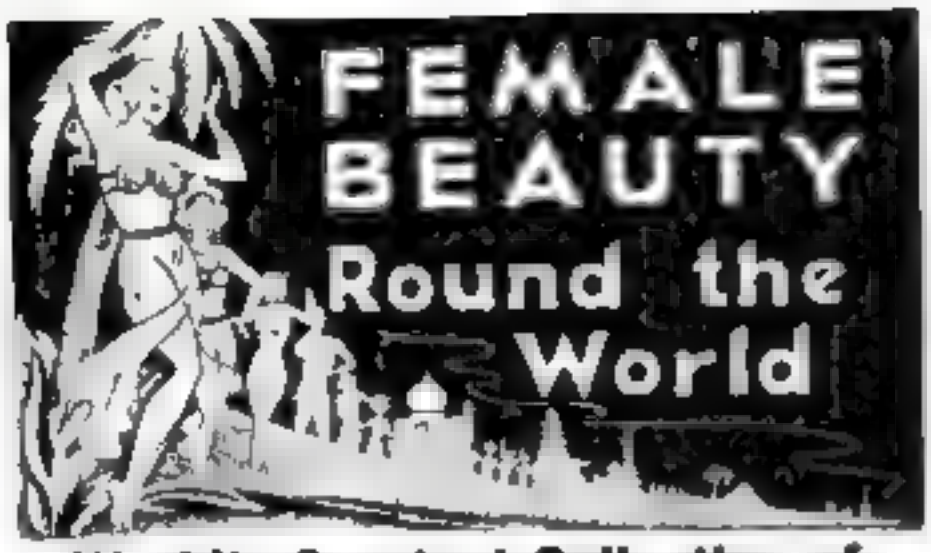

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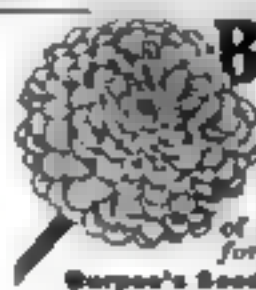

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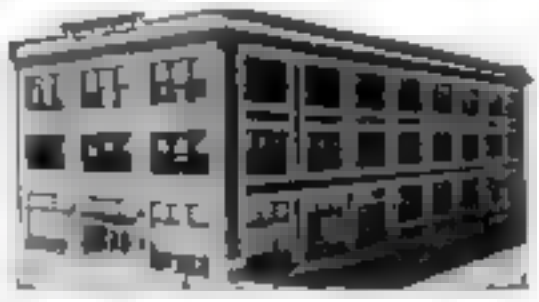

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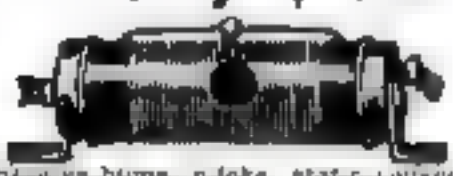

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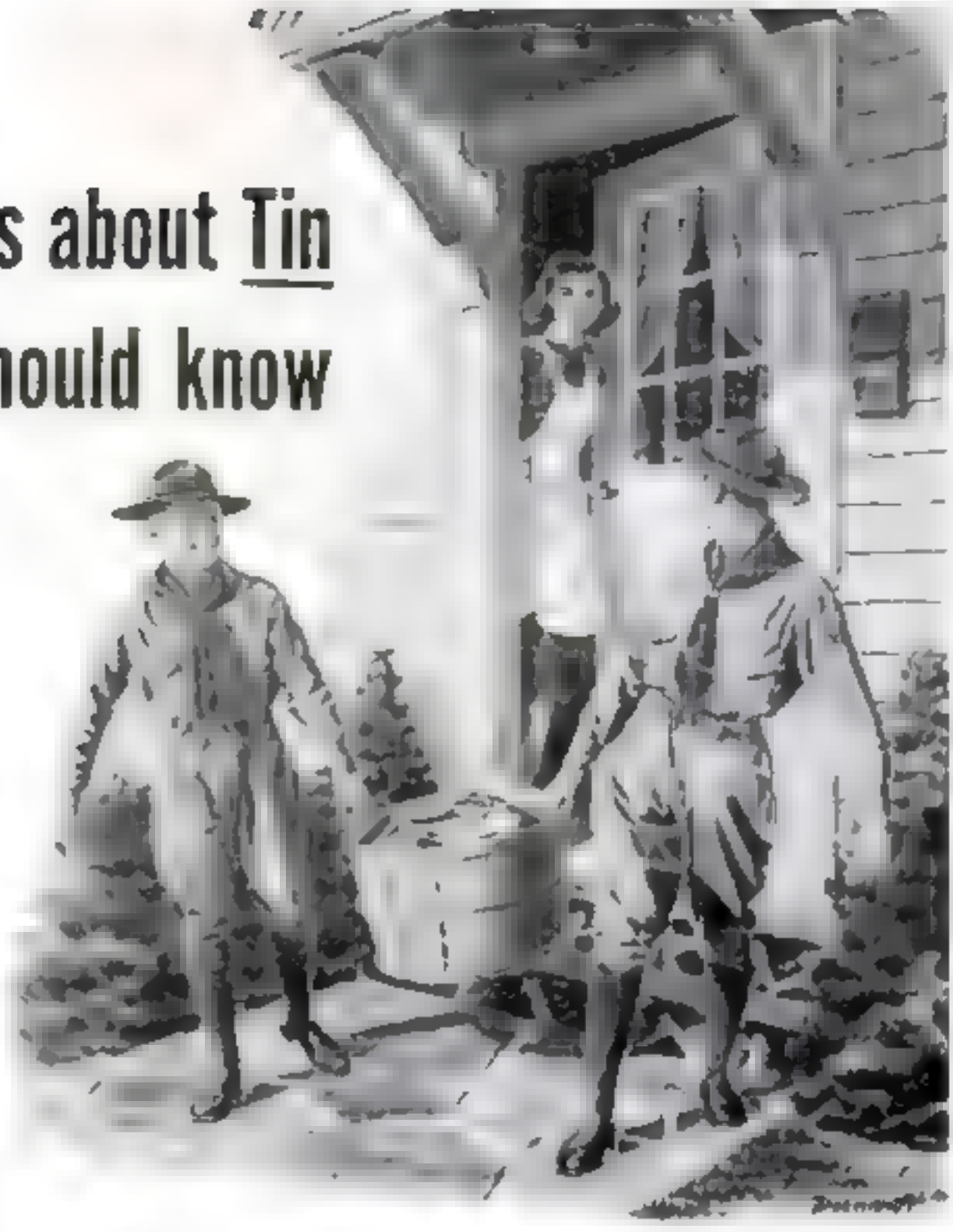

IT'S NO SECRET that the Japs are camped on 80% of the world's tin supply and that America is facing a critical tin shortage.

You have been asked to salvage every single tin can you use—to save every possible ounce of this vital war material. But, today, there is *good* news about the tin you salvage—and we believe you should know that news.

This is it: A new electrical process makes the tin used in tin cans go 3 times farther now than it did before.

Tin plate was formerly made by dipping thin steel sheets in molten tin. It produced a satisfactory coating, but used more tin than was really necessary.

American engineers devised a new method—*electroplating* the steel with pure tin—and the result was a coating that required only *one third as much tin*.

But the new tin plate had disadvantages. It was porous and did not provide complete protection against the acids in certain kinds of food.

Then Westinghouse stepped in.

Our research men and engineers, in co-operation with engineers of the steel industry, found a way of using *radio* waves to *heat* the dull, imperfect surface so that the tin fused almost instantly into a smooth, protective coating.

And the process is fast. A single machine can turn out enough tin plate in 18 minutes to cover an area the size of a football field!

This new device is a typical example of *electronics at work*—a result of Westinghouse electrical research and "know-how." Already it is being installed in mills that turn out tin plate for a third of all the nation's food cans.

Naturally, this does not mean that there is less need for you to salvage your old tin cans. On the contrary—*more than ever, tin* is needed to protect the food supplied to our fighting men all over the world.

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PLANTS IN 25 CITIES—OFFICES EVERYWHERE

Nerve Center of the Fighting Forces

WASHINGTON'S COLOSSAL PENTAGON BUILDING

By ALDEN P. ARMAGNAC

YOU stop at a reception desk and ask to see the Army officer with whom you have an appointment. Casually the operator calls Extension 73,759

"His office is 2E250," she tells you. "Please wait for an escort."

You are glad to have a guide. You are in the largest building in the world, the Army's newly completed Pentagon Building at Arlington, Va. Nerve center of our fighting forces all over the world, it now houses War Department personnel formerly scattered throughout Washington, D. C., in 17 different buildings. The result of this centralization, which effects a tremendous gain in efficiency in the department's job of directing a global war, is a city of 40,000 workers under a single roof.

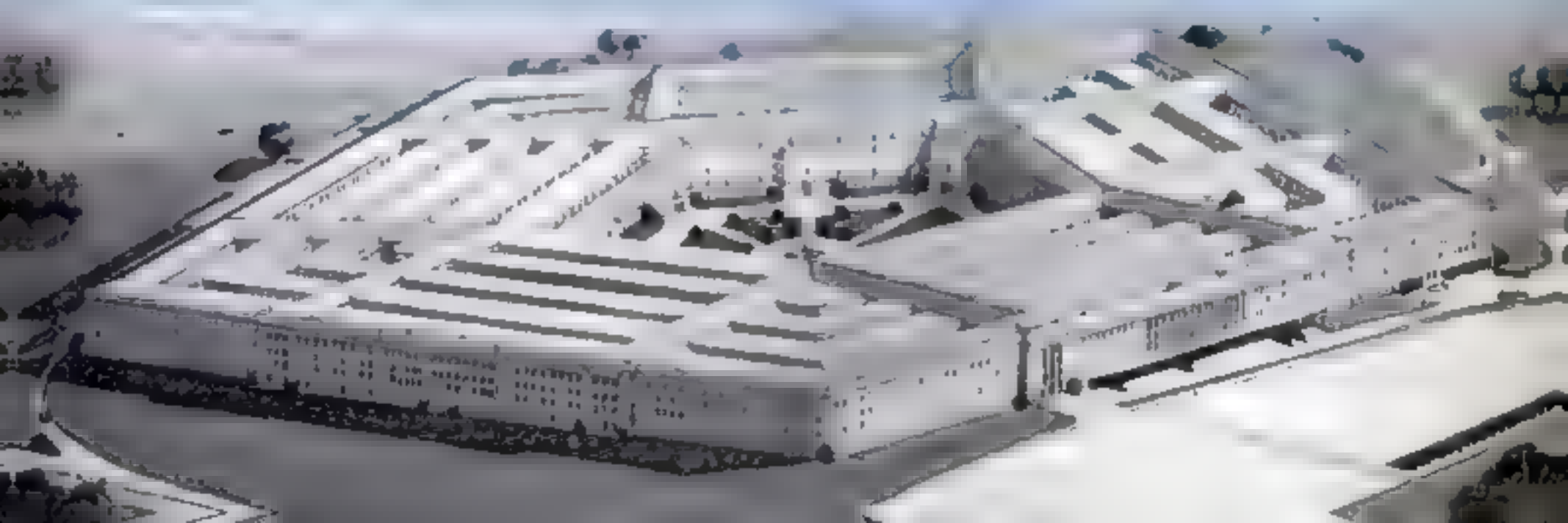
Your approach gave you a view of a low-lying building, faced with buff limestone and roofed with dark-green slate—remarkable only for its great length. Actually you saw only one or two of its five concentric divisions that ring a central court like a medieval fortress. The structure camouflages its sheer immensity. Once inside, you experience something of the sensation of a tourist viewing Niagara Falls for the first time. You walk more than a city block, part of another—and even then you find that you have only reached the six-acre central court.

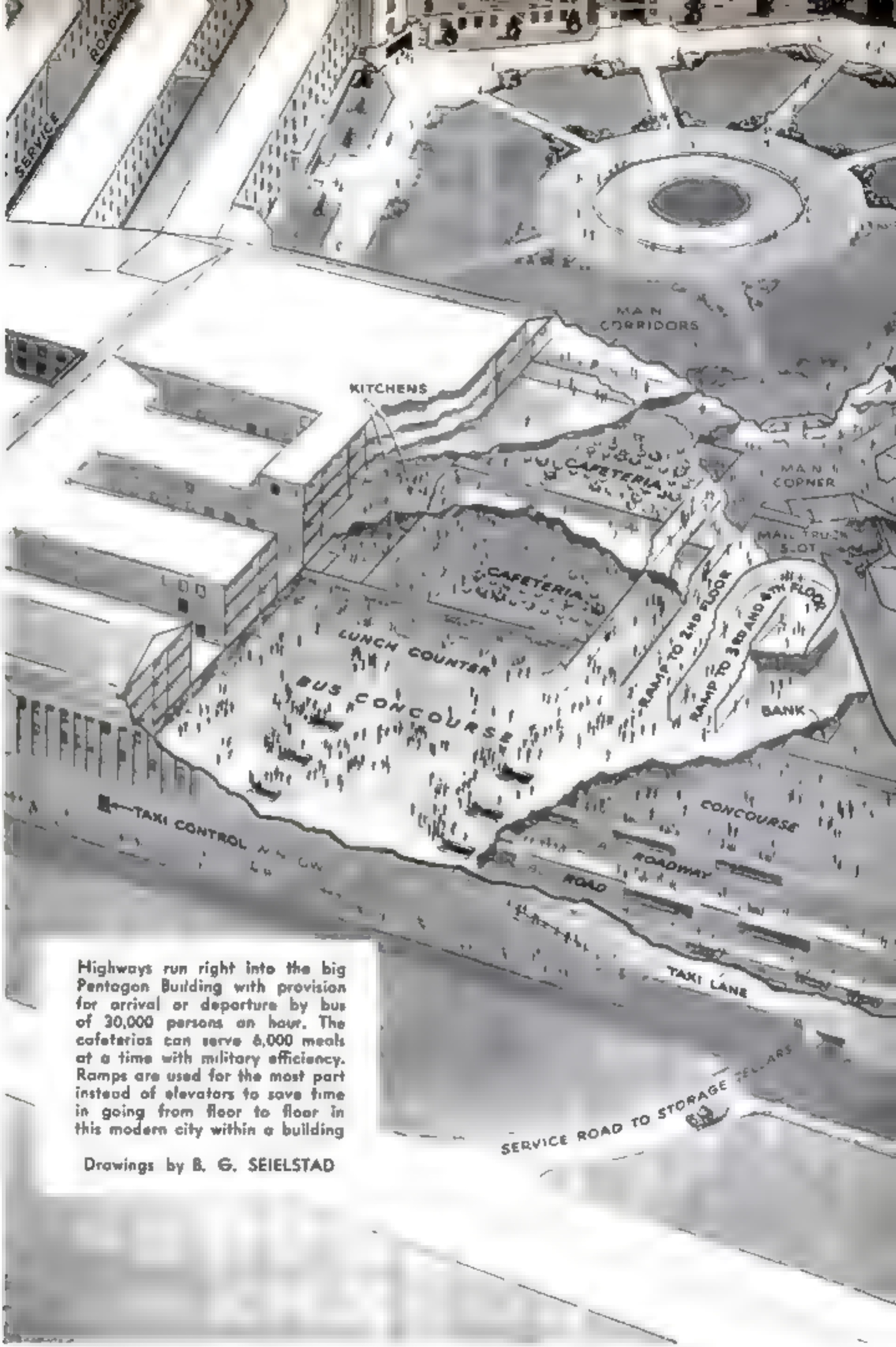
Torrents of humanity swirl through its corridors—Army officers and men, civilian specialists, stenographers, cafeteria waitresses, switchboard operators, messengers. At once you are impressed by the absence of confusion. Everyone seems to know exactly where he is going, how to get there—and keeps moving. A maze of passageways that first bewildered you turns out, on further acquaintance, to be a masterpiece of scientific design.

Planning this architect's dream called for the aid of geometry. In theory a perfect circle would be ideal for access to all offices More practical structurally, a ring of straight sections would approach a circle closely enough. Thus evolved, upon the drafting board, the five-sided or pentagon shape from which the giant building takes its name. Working day and night, 15,000 men have transformed the dream into reality in the record-shattering time of 15 months.

From a main corridor bordering the inner court, numbered corridors extend radially to the outer rings. They intersect concentric, lettered passageways in each ring, forming a spider-web pattern. The main, inner corridor becomes a short cut between distant parts of the building. Though the structure measures nearly a mile in *(CONTINUED)*

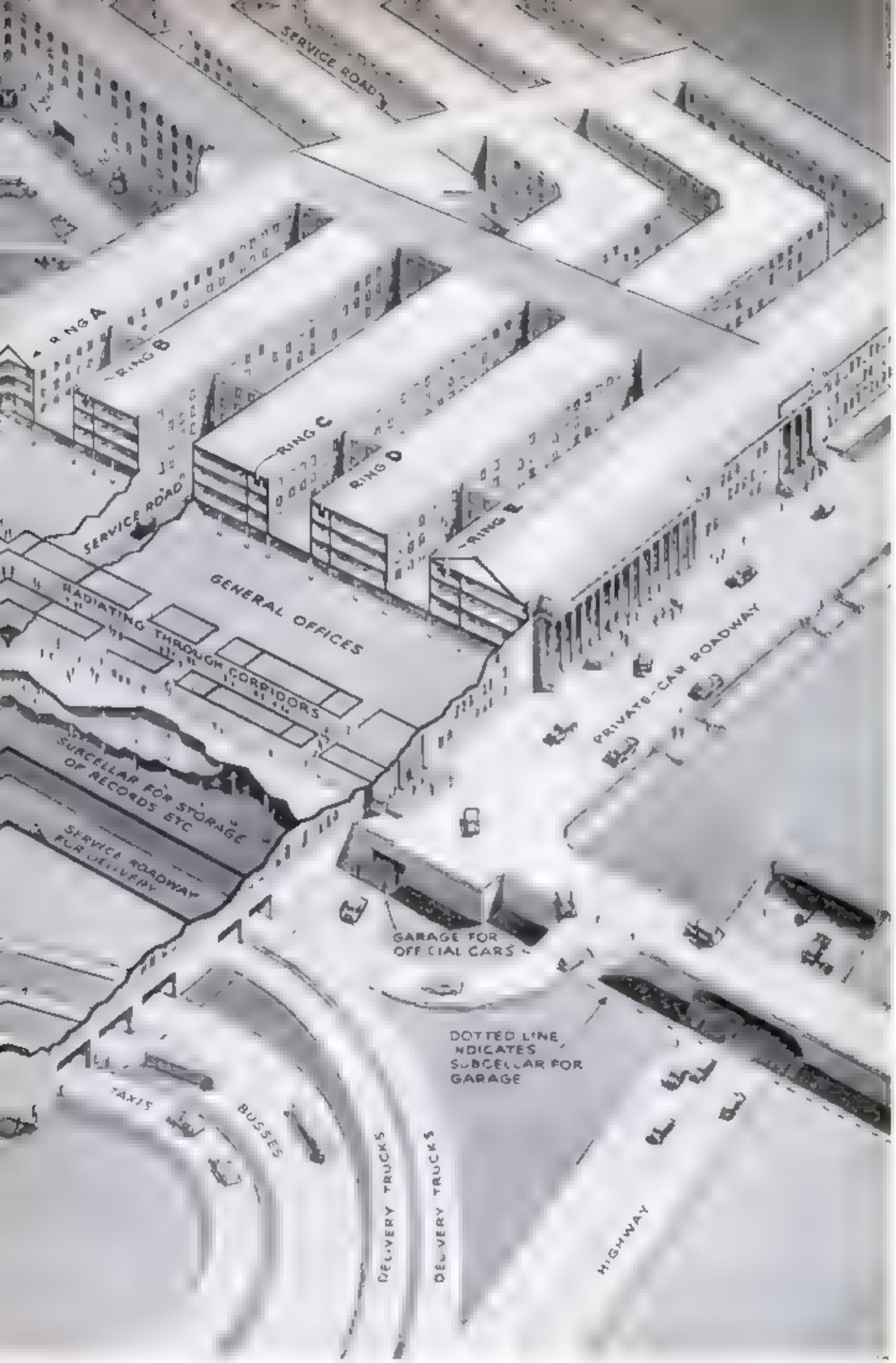
Here in this five-sided building across the Potomac from the city of Washington is the nerve center of our fighting forces—the offices of the War Department. Measuring nearly a mile in circumference the building still provides easy access from one office to another, and easy access, too, to the capital





Highways run right into the big Pentagon Building with provision for arrival or departure by bus of 30,000 persons an hour. The cafeterias can serve 6,000 meals at a time with military efficiency. Ramps are used for the most part instead of elevators to save time in going from floor to floor in this modern city within a building

Drawings by B. G. SEIELSTAD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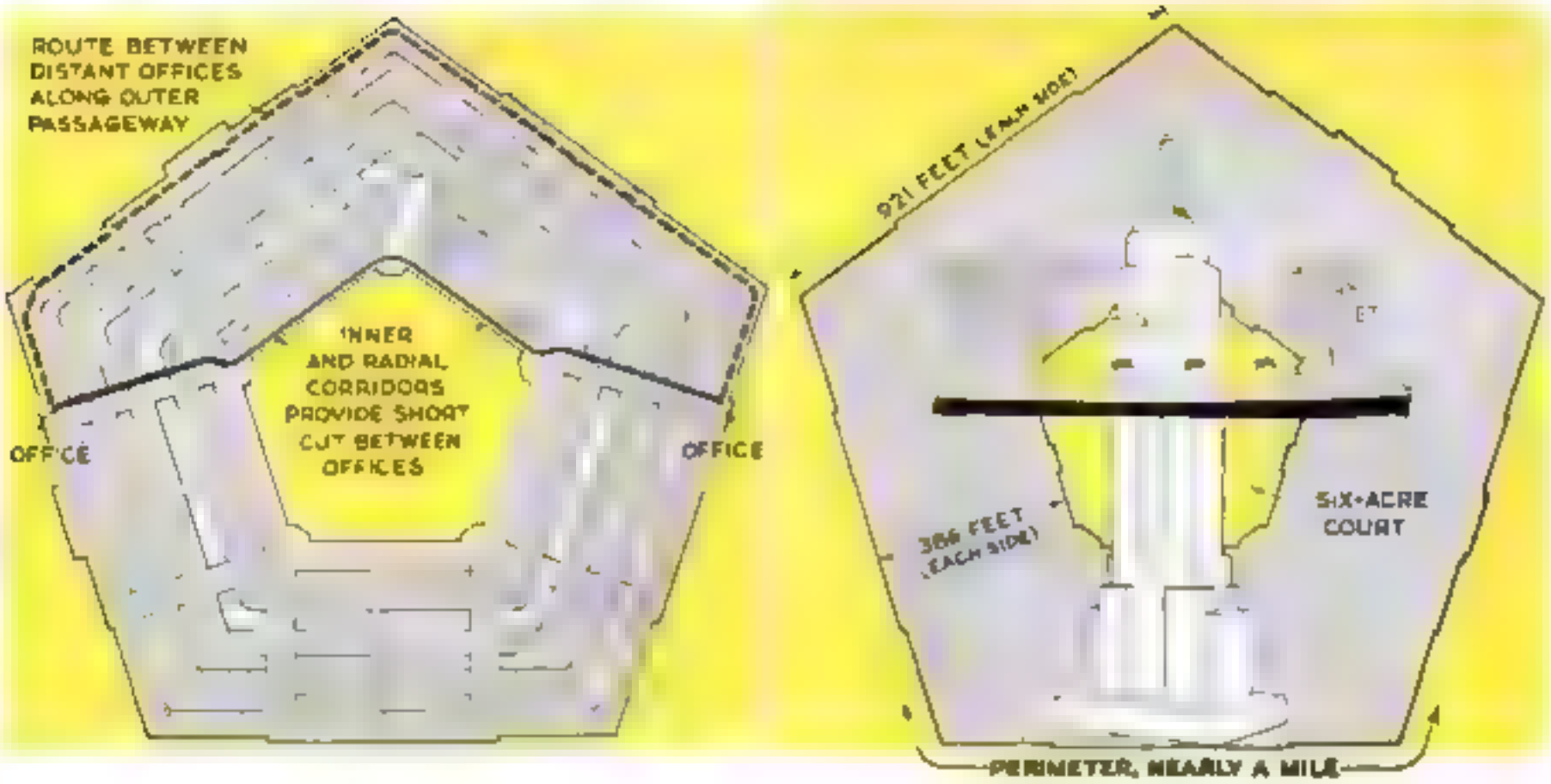


This pentagon design was chosen to save steps in going about the huge building. Passageways are scientifically laid out so that maximum walking distance on any of the five floors is 1,800 feet

Compared with the height of the big Empire State Building or the length of the liner Queen Mary, the immensity of the area covered is easily seen. The total floor space is 4,000,000 square feet

perimeter, the maximum walking distance between two offices on the same floor is 1,800 feet, and this is an exceptional figure.

The mystifying symbol "2E250" supplies exact directions for getting to the office it designates. Translated, it becomes, "Second floor, Ring E, Corridor 2," and the remaining numbers indicate the door.

Because the $49,000,000 Pentagon Building is a low one, it has been possible to dispense almost entirely with passenger elevators, yielding the dual advantage of saving space and of avoiding delays and congestion. For vertical travel, occupants use ramps and escalators.

Of the building's occupants, the most prominent include Henry L. Stimson, Secretary of War, and Gen. George C. Marshall, Chief of Staff of the United States Army. Allocation of offices in the various parts of the building was carefully planned to facilitate co-operation between officials and departments in related fields. Each floor has walls and pillars of a distinguishing color. Brown identifies the first floor; green, the second or main floor; red, the third floor; gray, the fourth floor; and blue, the fifth floor.

Offices range in size from small rooms to working spaces as large as 50 by 400 feet.

Providing telephone service for the new $35,000,000 War Department building in Arlington, Va., was a gigantic undertaking in itself. Here one of two barges employed starts paying off six of the twelve cables to Washington across the Potomac. The lines lay in 2,000-foot trenches dredged in the river bed

Total floor space reaches the staggering figure of 4,000,000 square feet, considerably more than that of the previous biggest building—Chicago's famed Merchandise Mart. Year-round air conditioning assures comfort.

Nearly 300 operators, at the world's largest private branch switchboard, daily put through a total of about 200,000 outgoing and incoming calls. Interoffice calls, numbering more than 100,000 a day, are handled automatically. Construction of a switchboard of unprecedented size required special research by engineers of the Bell Telephone Laboratories, the Western Electric Company, and the local telephone company, to solve its intricate technical problems. Telephone cables within the Pentagon Building contain nearly 150,000,000 feet of wire.

Twelve submarine cables, each 2,000 feet long, cross the Potomac River to connect with a smaller, completely automatic "satellite switchboard" in Washington. This serves Army offices remaining there. The cables also link the Pentagon Building with the nation's telephone system. From Arlington, special barges slowly traveled across the river unreeling the cables into trenches previously dredged on the bottom. A diver followed in the wake of the barges and guided the cables into their beds.

Within the building, dispatches and written memoranda travel by messenger, or are shot through a pneumatic tube system in conveyors that accommodate flat documents up to 10 by 14 inches in size.

Enormous cafeterias, staffed by well-trained help, feed as many as 6,000 persons at a time with military efficiency. Duplicate counters at opposite sides double the number of patrons that may be served at once. Looking around the mass of occupied tables, you miss something—the deafening babel of a crowd of people in animated conversation. A sound-absorbing acoustical ceiling takes care of that.

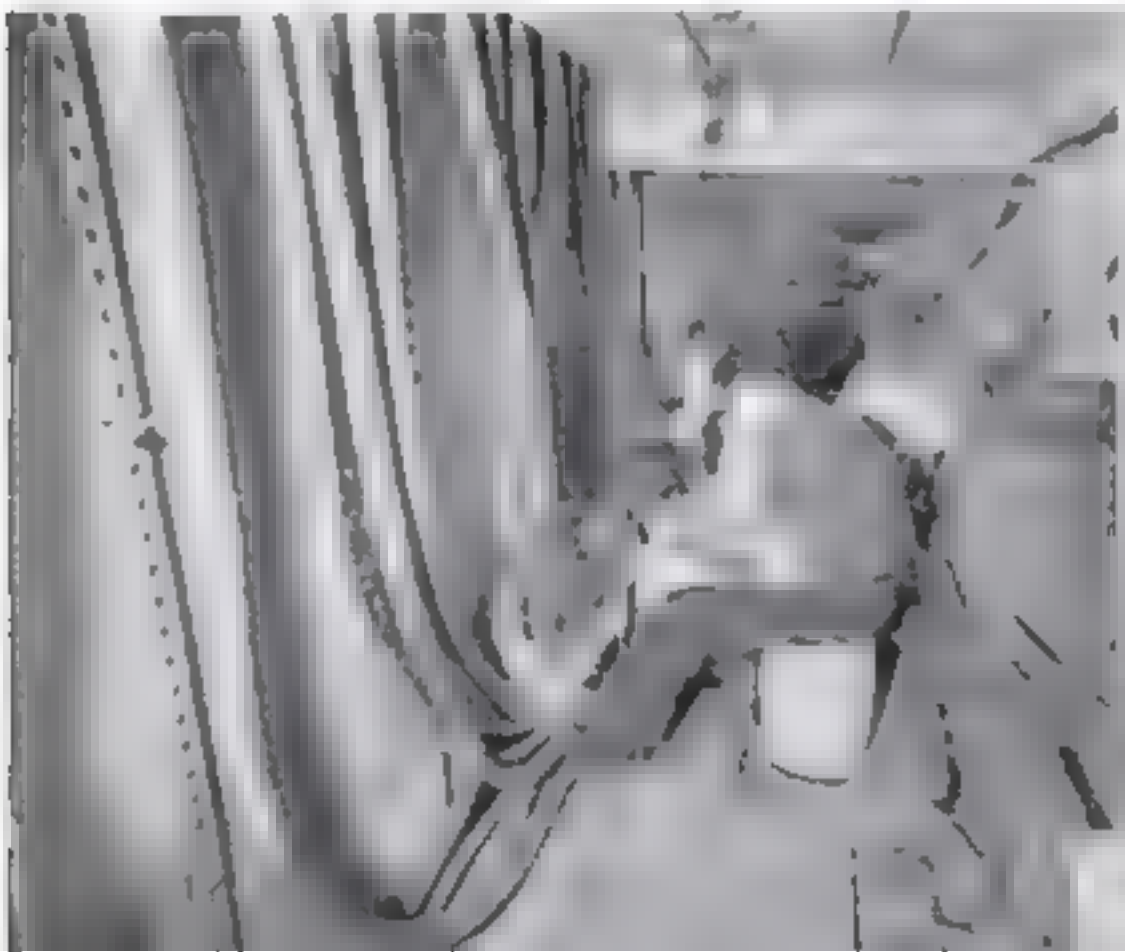
Transporting a city's population to and from a single building each day presents a major problem that has been solved on a correspondingly grand scale. A three-lane bus and taxi terminal, with facilities rivaling those of a great railroad station, extends beneath a concourse 680 feet long and 150 feet wide. As many as 28 busses may be loaded simultaneously in each of the two bus lanes, and 300,000 persons may arrive or depart in an hour. Fares are placed in turnstiles, and busses are announced and dispatched by an electrical control system. For those who drive to work, two enormous paved areas, north and south of the building, provide parking space for 8,000 cars. Within 60 minutes, the spaces can be filled or emptied. Staggered hours are expected to expedite traffic.

New highway projects, including four clover leaves and connections with through routes, afford speedy travel to any point of the compass, including near-by Washington. Thus the war center has been removed from the congestion of the capital, but has been kept within quick access.

By choosing a framework of reinforced concrete, architects and engineers have saved thousands of tons of steel for war needs. They have built a permanent building, they point out, for little more than the cost of a temporary one. Fifty or perhaps 100 years from now, the Pentagon Building is expected to be still playing its part in guarding the nation.

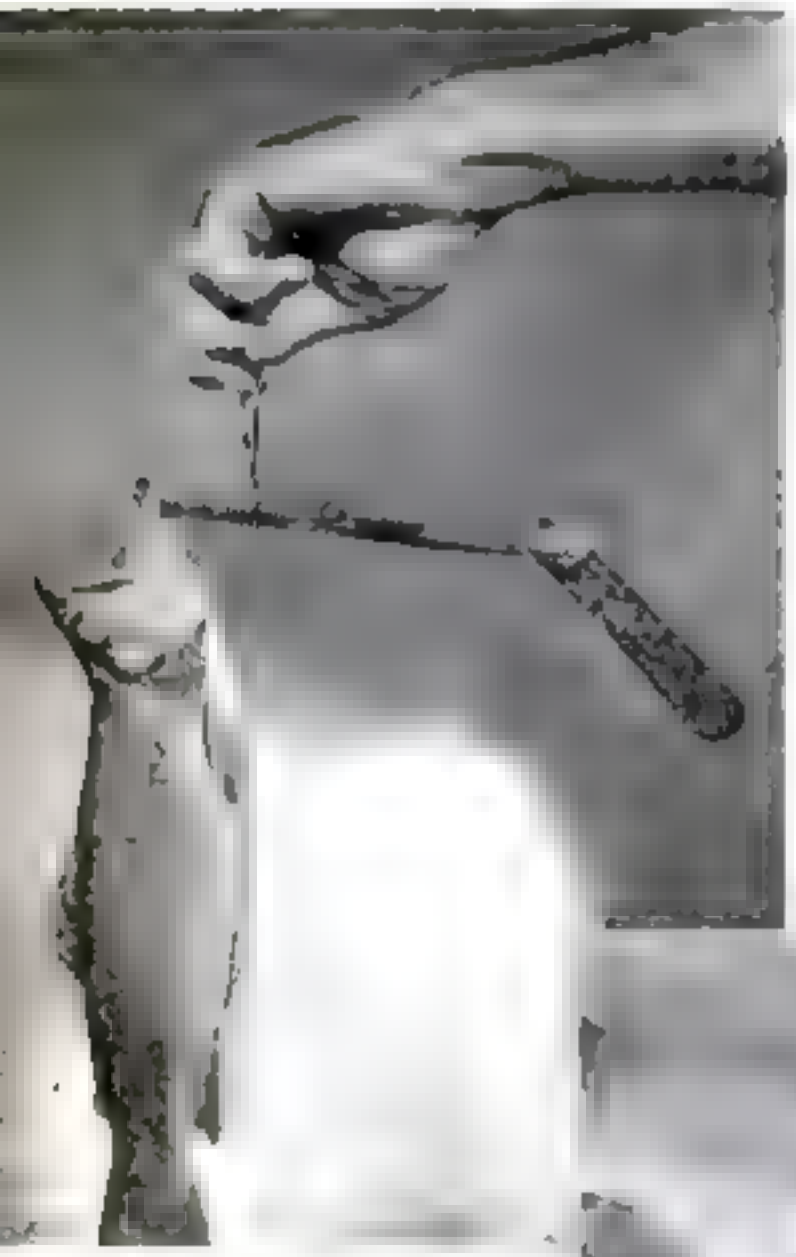
Below, splicing incoming underground cables to interior cables in a communications link that handles 200,000 incoming and outgoing calls a day. Telephone cables in the Pentagon Building contain nearly 150,000,000 feet of wire connecting to 9,990 pairs of outside wires

Switch units like these are key mechanisms for controlling the world's largest private branch switchboard installed in the Army's new central building. Nearly 300 operators are employed in expediting the connections



Here is a knife that does everything to a fish but catch it and cook it. Closed, it looks like any pocketknife; opened, it has two blades joined end to end—and it scales, cleans, and weighs the fish

Knife Puts Fish on Scales

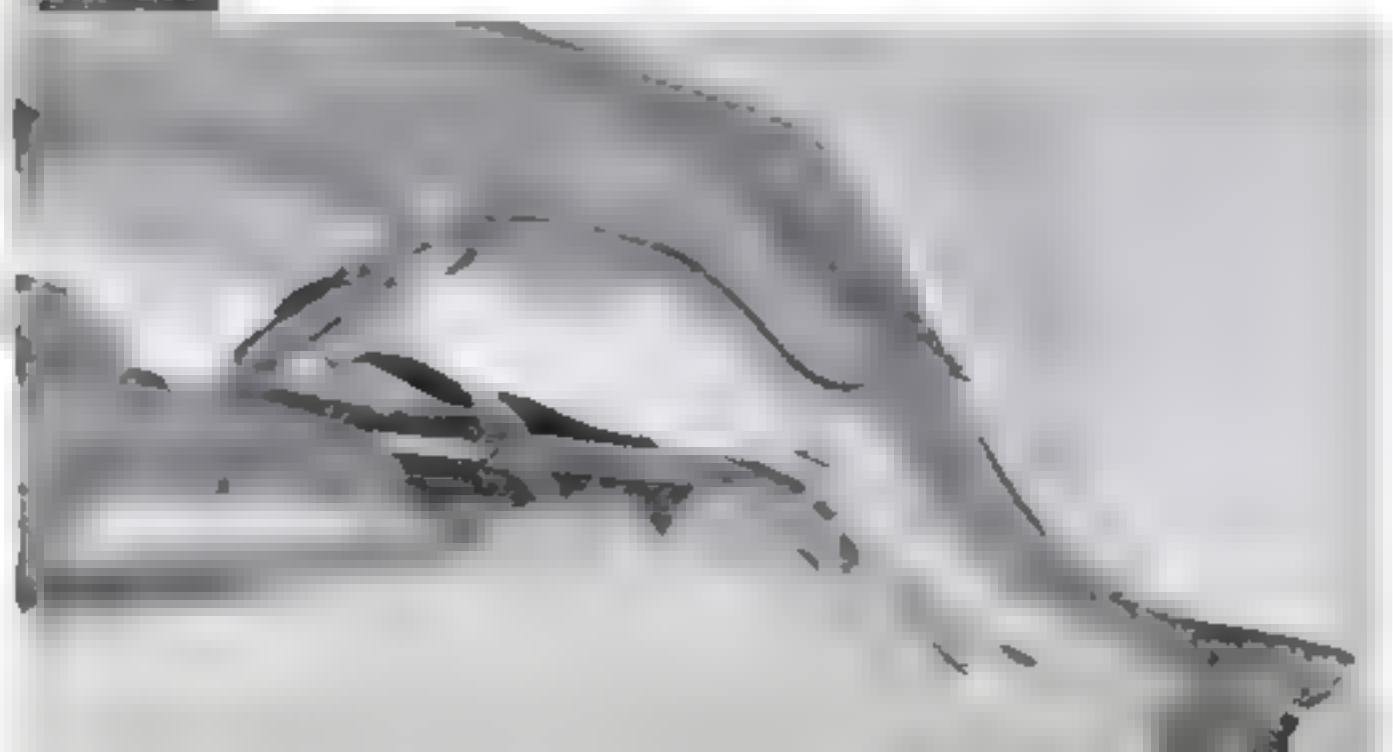


Slotted blades is beam, belt clasp is fulcrum, and handle is weight when the knife is used as scales. Its sharp, hooked blade cuts clean

FISH can be weighed as well as cleaned and scaled with a new all-around fish knife invented by J. M. Robinson, of New York City. This knife, which he calls a Fishweigh knife, looks like an ordinary pocketknife when it is closed; but opened, it discloses two blades hinged end to end—one for cleaning fish, the other for scaling them.

These two blades, which lock together in a straight line when open, are notched in quarter-pound divisions to serve as a scale beam when a catch is weighed. The fish is suspended from a sharp ripping hook at the end of the outer blade, and the ring-belt clasp—removed from the butt of the handle—is used as a fulcrum. The handle itself serves as a balance weight at the other end, and can correct the weight to the nearest ounce by being shifted to one of four different angles.

The knife is capable of weighing fish up to as high as six pounds. For heavier fish, thin metal strips can be attached to the handle which will increase the knife's range up to ten pounds.



Exploding COCKPIT

SHOOTS PILOT FROM STRICKEN AIRPLANE

TRAPPED in the cockpit of his burning or falling plane, a pilot of the new German Focke-Wulf 190 fighter can instantly blow off the transparent cover and throw himself clear of the doomed ship. The "exploding" cockpit feature, found to be part of the equipment of a plane recently forced down on British soil, is operated by a handle mounted on the instrument panel. When this is pulled, it fires an explosive cartridge which, in turn, shatters a lock bar that holds the cockpit cover in place. Snatched by the slip stream from the propeller, the cover flies off. If possible, the pilot turns the plane over on its back at the same time that he jettisons the cockpit cover; this enables him to fall quickly and easily into space.

Another innovation in the rescue gear is that the pilot's parachute pack is carried on his back while his collapsible dinghy is folded into a cushion on which he sits. If he is forced down into the sea, the pilot can, by turning the screw of a compressed-air cylinder, inflate the dinghy in a matter of a few seconds, his flotation jacket keeping him afloat in the meanwhile.

Storing Gas One Mile

PUMPED BACK INTO THE GROUND THROUGH OLD OIL WELLS, FUEL WILL SUPPLY WAR INDUSTRIES

TO KEEP war industries fueled during periods of extreme cold and heavy loads, California authorities are storing more than a mile underground three billion cubic feet of natural gas—enough to keep a million homes warm for a month. Collected from a score of fields along a 200-mile front in Southern California, the gas will be compressed and forced down five oil wells in a 240-acre area of the Playa del Rey field, near Venice. When needed, it will be extracted and supplied to war-plant users in the Los Angeles area.

Eight 200-hp. compressors will take over the job of injecting the gas, under pressures as high as 850 pounds per square inch. A 16-inch pipe line will carry the gas from other fields, including the famous Kettleman Hills and the Ventura field, most of it coming from the latter area. One billion feet of gas will be held in the Playa del Rey field as a base, with two billion serving as a floating supply to be withdrawn when needed.

During its lifetime Playa del Rey has yielded 10,000,000 barrels of oil and five

Laying a 16-inch pipe line through which natural gas will flow to war-industry plants in the Los Angeles area from subterranean storage places. Drawn from oil fields in surrounding country, the gas will be forced down five oil wells by compressors like those seen at the right, forming a reservoir from which as much as 30,000,000 cubic feet a day may be drawn

Down

billion cubic feet of gas. Now gas pressure has dropped to 50 pounds per square inch at the wells. Because the producing zone of conglomerate oil sand "pinches off" at the sides, thereby preventing gas leakage, geologists think gas can be stored in this natural reservoir indefinitely.

It is anticipated by Professor John Dodge, University of Southern California geologist and consultant to the California Railroad Commission, charged with developing the project, that seldom will more than 30,000,000 feet be withdrawn in a single day. During periods of peak demands, the Los Angeles area consumes 500,000,000 feet daily.

Tests made in other fields show that no physical or chemical changes take place in the injected gas, and that it emerges with the same heat value as when originally taken from its home field.

Plans are also being made to pump surplus gasoline back into California oil fields. As with gas, gasoline will be stored in selected fields where it will not wander away. The characteristics of the oil are such that gasoline will not be ruined. Studies made by California oil companies show that in some instances, gasoline injected into a field precipitates solid asphalt from the oil, thus setting up barriers which make future production impossible. Gasoline restored to the earth will be forced into structures containing light oil, and sand through which it can flow easily.

Formations in which natural gas is to be stored are selected according to size and location, by means of electrical logs and from core records of various wells. All must be closed structures to keep the gas from seeping away. Gasoline also may be stored underground this way

ON BATTLE LINES OF TEST-TUBE SOLDIERS

Chemists

By ALFRED H. SINKS

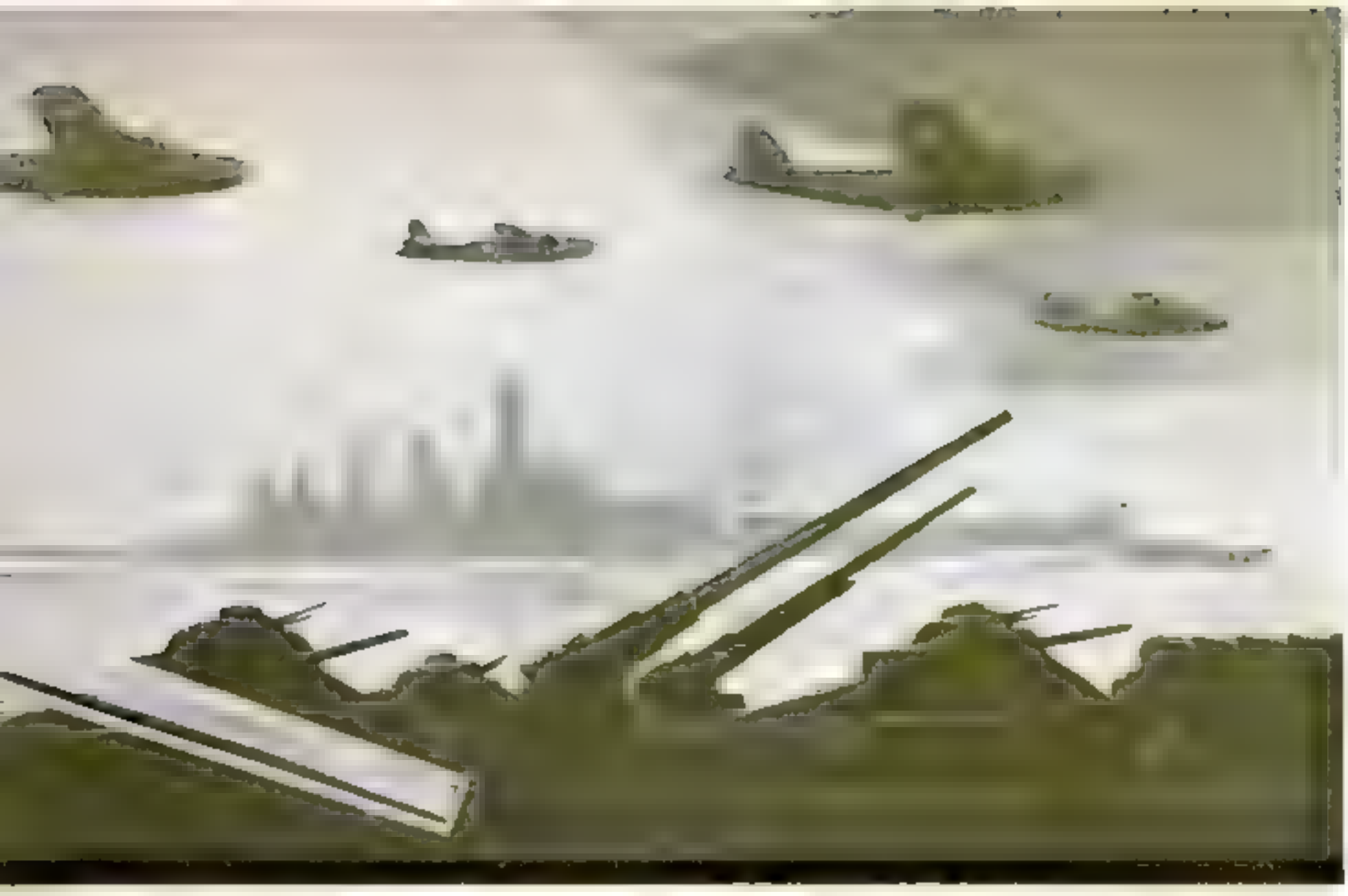
LIKE you and me and 130,000,000 others, the American chemist is in this war to win. But unlike most of us, he's fighting it on a thousand fronts at once. He sees that Marines pushing forward in the South Pacific have more punch in their ammunition, that our planes have the extra snap and drive of high-octane gasoline, that there is TNT in those 8,000-pound bombs that drop on German war plants. At the same time it's his job to see that Tom Jones, defense worker, doesn't get sick from exposure because he can't get a wool overcoat, a rubberized raincoat, or medicines. And that Mrs. Jones' table has variety even though tin is needed for war industry and can't be spared for cans.

This war is being fought by billions of people using hundreds of thousands of things. It's being fought with everything from high explosives and heavy metals to that tiny bit of plastic that goes into the tips of your shoelaces in order to save that much more metal for ships and tanks.

Thousands of those things are born in the test tube or under the microscope. The chemist has been drafted for the duration. His job is as vast as global war: new, better, quicker ways of making the old things . . . new things to take the place of the old where shortages threaten war production or civilian comfort.

For chemistry at war doesn't mean just poison gases like chlorine, phosgene, or lewisite. It doesn't mean "secret weapons." It means new landing fields for fighting planes created overnight. Chemistry does that. Barrels of dilute sodium silicate poured over raw meadowland toughens the ground and saves weeks of digging, of hauling crushed stone for a foundation. Then a layer of new, quick-setting, tougher asphalt, and your war birds can hit the tarmac at 150 miles an hour with no fear of a crack-up.

It means tanks, trucks, and jeeps rolling forward under cover of a smoke screen made with chlorsulphonic acid. And the chemist had to find something to take the place of the chlorine that whitened your



LAND, SEA, AND SKY, AS WELL AS IN FACTORY AND HOME, FURNISH THE MATERIALS OF VICTORY AND A BETTER LIFE

Fight on 1,000 Fronts!

linen or bleached the pulp for your morning newspaper, to scrape together all the chlorine needed at the front.

The foot soldier behind those tanks owes a big debt to the chemist. The lining of his combat helmet is not metal. The stock of his Tommy gun is not wood. Both are phenol formaldehyde plastics compounded out of the same chemicals.

He may smash through enemy lines. The advance may carry him two or three days' march ahead of his field kitchens. But in his pack your doughboy carries several oblong packets of Ration K. Each contains the equivalent of three full meals—a day's rations, in a container the size of a sample box of breakfast food!

Special goggles protect his eyes against the glare of desert sands or arctic snows. And if the lenses should become scratched or dented, he merely throws them away and slips in another pair. Molded out of a light-polarizing, nonshatterable vinyl polymer, they are produced in a fraction of the time and at a fraction of the cost of grinding glass lenses. Best of all, eyeglasses are no longer a danger to the soldier in battle. Chemistry found the answer to that problem and to many others—like the danger of death from fire in a plane set ablaze by enemy incendiary bullets. Today your fighter pilot's flying suit may char, but it will not burn. It has been made flameproof with tricesyl phosphate or with ammonium sulphamate.

In field and base hospital, chemistry plays a major part. Army medical men are beginning now to talk about our "victory" at Pearl Harbor—the victory of sulfanilamide and sulfathiazole, made in the U.S.A. But the chemist has already passed beyond the miracle of the sulfa drugs. Synthetic urea, long used in making plastics, fertilizers, and beverage alcohol, is expected to save thousands of lives through a new technique for the treatment of wounds.

Malaria is an enemy more deadly than the combined Axis armies. Each year it kills more victims than died on both sides in the last World War. Without quinine, or some other weapon against malaria, our soldiers could not hold out for a month in the South

Pacific, Africa, or India. Our major sources of quinine are in Japanese hands today. Yet, less than a year after Pearl Harbor, three new American-made drugs, plasmoquin, atebrin, and totaquine, are competing for the honor of filling quinine's shoes. The first two are synthetic quinines. The third is made, like quinine, from cinchona bark. South America cannot supply us with enough cinchona bark to give us the quinine we need. But it *can* ship us enough to make a little quinine, plus *plenty* of totaquine. That's good news not only for our fighting men in tropical countries, but for something like 1,000,000 civilians in the United States who have malaria today.

These jobs sound important enough, and thousands of them add up to big figures on the score card of total war. But there are far bigger jobs.

Let's look at the new heavy artillery of American chemistry at war. These big guns are the latest fractional distillation towers and cracking plants for breaking down crude oil into many vital war materials. More impressive than the biggest blast furnaces of the steel age, the huge batteries of sleek, cylindrical columns are like cannon aimed to shoot half way round the world—which is just what they are doing.

Within two years, they will be turning out enough butadiene to give us more than 1,000,000 tons of synthetic rubber. From those towers, instead of the plantations of Malaya, will come the tires for our trucks, tanks, planes, pontons, self-sealing gasoline tanks, and gas masks—as well as for our own aging cars.

From those same heavy batteries will pour motor fuel—100-octane and far higher if our engineers can design motors to make full use of such gasoline—light oil; benzene; acetylene for plastics, rubber, and synthetic textiles; and toluene.

Suppose a chemist had walked into the G.H.Q. of the Allied High Command in 1917 and said: "Gentlemen, give me plenty of petroleum—just plain crude oil—and money to build plants, and I'll guarantee you as much TNT as you can use!" What would have happened? The august generals would have shipped him off to an asylum

Trinitrotoluene — innocent-looking pale, yellow crystals made up of carbon, hydrogen, oxygen, and nitrogen is the demon destroyer of modern war. TNT is made from toluene and nitric acid. Step it up with more nitrogen in the form of ammonium nitrate and you have amatol, another deadly explosive.

In World War I the Allies had to depend for nitrogen compounds on natural nitrates, chiefly Chile saltpeter. These had to be mined, lugged

BREAKFAST consists of meat, two kinds of crackers, soluble coffee, sugar, malted milk and dextrose tablets, and chewing gum

In the U. S. Army's Field Ration K, chemistry has packed three square meals into as many compact units weighing a total of less than two pounds. Here Maj. W. E. Harper of the Army's Subsistence Research Laboratory compares the bulk of the dinner unit with that of a comparable ordinary meal

hundreds of miles to the seacoast, loaded onto ships. Those ships—thousands of them—threaded their way painfully across the world's oceans at six or eight knots. Then, unless they were sent to the bottom by German subs the nitrates were unloaded, shipped again, refined, treated with sulphuric acid, and finally made into nitric acid for explosives.

Toluene, the other partner in the combination, has a romantic history. Discovered by a French chemist just 100 years ago in the balsam of the *tolu*, a tree that grows in South America, it was later obtained from the balsam of an Asiatic palm, called "Dragon's Blood." Its chief use then was to give a pleasant taste to cough sirups. But before it found its way into the manufacture of high explosives, toluene was being recovered from coal tar.

At that particular job, the Allies were hopelessly outclassed. The chemists of Germany were years ahead in breaking down that black, sticky mass called coal tar, a by-product of the coke ovens that furnished fuel to her enormous steel industry. From it, the Germans had built up a long list of synthetic dyes and drugs, and they were ready to turn their skill to more deadly work.

But the American dye industry was in its infancy 25 years ago. It could turn out no more than a fraction of the toluene needed by the Allies.

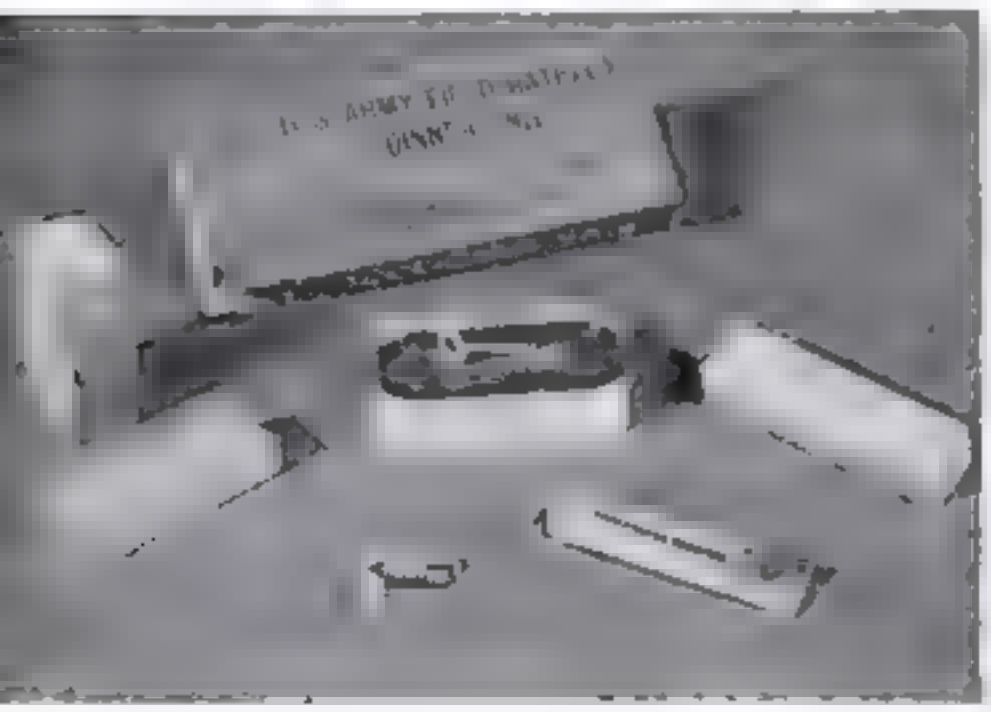
Yet since Pearl Harbor the rash promise of "all the TNT you can use" has been made by American chemists. And it will be kept. For American petroleum chemists have learned to make toluene from crude oil far faster than it can be synthesized from coal tar. When our plants are finished, toluene will pour out in quantities to match our new production of nitrogen, which will literally be snatched out of the air through the high-pressure synthesis of ammonia!

High-octane gasoline is really the grandfather of the TNT bombs that drop on Germany today—a grandfather only five years old! It was while seeking means of making more high-octane fuel that petroleum chemists discovered they could break crude oil down and reshape it into a host of other things. In working for more and better high-octane, they learned to make hydrocarbon, ethyl and methyl alcohol, and other carbon-hydrogen-oxygen compounds that are the bricks and stones from which are built lacquers, paints, varnishes, and solvents; rayons and plastics; dyestuffs, textile and leather oils; synthetic rubber; medicines, chloroform, poisons, toiletries, tear gas, poison gas, vitamins, soapless soaps, a spray to ripen green fruit after it has been picked—and toluene! They discovered that it is possible to make from crude oil many things that can be obtained from coal tar.

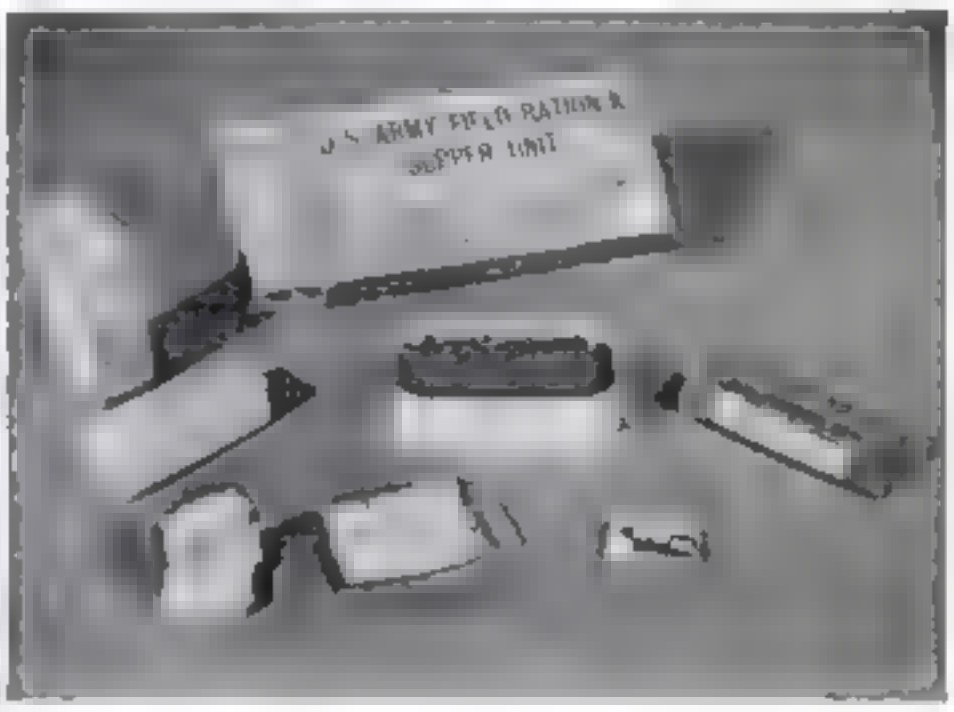
Not only in big things are our battles being fought and won in American laboratories. Some of the lesser skirmishes are nearly as important and just as interesting.

Early in the defense program the Army's ordnance men realized that a shortage of brass would hold up the manufacture of cartridge cases. Unlimited TNT would win no wars unless we had the cartridges. To make the cases out of thin-gauge steel was easy. Copper plating would take care of the outside. But the inside must withstand nitrocellulose, nitroglycerin, acetic acid, ammonium hydroxide, ethyl alcohol, and ethyl ether. If it is coated, the coating must resist extremes of heat and cold. It is worthless if it scratches or chips off when the shell is loaded. The chemists of Frankford Arsenal found the answer in a straight, water-clear, phenol formaldehyde baked-on

DINNER (noon meal) includes meat, crackers, a tube of concentrated bouillon, dextrose tablets, and again a stick of chewing gum to top it off



SUPPER is crackers, meat, a "Ration D" chocolate bar, sugar, powdered lemon juice, and chewing gum. Both the "D bar" and the lemon juice are fortified with vitamins



finish. Yes, you skeet shooters and rifle fans, the day of dependence on expensive brass for cartridges is past.

Armies that have to fight in all kinds of climates use staggering quantities of wool. It would take nearly the entire wool clip of the United States for two years to outfit every soldier in our Army, not counting civilians or the troops of our allies! Yet the spoilage of woolen goods is tremendous, as every housewife knows. One female moth and her descendants can, in a single year, destroy as much wool as 13 sheep can produce! Soap alkalis ruin wool, while certain enzymes decompose it and some bacteria seem to thrive on it.

IN ITS molecular structure, wool differs from all other fibers. Long chains of molecules are joined together by other, weaker chains, sprouting in all three dimensions. It is these weak cross links which are broken down by the moth's digestive juices or the soap alkalis, so that the tougher chain fibers fall apart.

Chemists of the Bureau of Standards have an answer to the problem. They do the moth's work for her. They *dissolve* the weak disulphide or cystine bonds of the wool with soluble organic sulphur compounds known as mercaptans. Then they *replace* the severed bonds with a chemically stable material through the use of a reagent like methyl or ethyl dibromide. The chemical reagent builds new cross links that are proof against moths, alkalis, or bacteria. And so you have wool that is mothproof and can safely be washed with ordinary soap! Jot this down in your notebook for V-day. The woolen suit you buy after the war may be a trifle more expensive, but it will outlast the old one four to one. And no expensive dry cleaning. It'll go right to the laundry with your socks.

If you stand on the sidelines, it looks as though American chemists sprang suddenly to life on December 7, and have been frantically pulling rabbits out of hats with both hands ever since. It is true that they have crammed into a few months progress that would normally have taken years. But looking at that, and that alone, does not give a fair picture.

When guns stopped talking in 1919, our chemists began their conquests where our soldiers had left theirs. They took from Germany her leadership in the synthetic-dye industry. They gave us improvements in stainless steel and a host of other improvements in heavy and light metals. Research on silicates let the sunlight into our skyscrapers through walls of glass brick; developments in refrigerants and insulators gave us air conditioning and quick-freeze food storage, and freed us from lifelong servitude to the whims of climate.

We got a whole world of new plastics out of coal, air, and water; synthetic rubber; aluminum in our planes, automobiles, railway cars and kitchen stoves; practically indestructible finish on our cars; high-octane gasoline, neon lighting, nylon stockings, rayon underwear, vitamins that streamlined our eating, and sulfa drugs that revolutionized medicine.

Our chemists were producing for peace, not war. But they were training men, perfecting techniques, building a vast machine that needed only a signal to slip into high gear for war production if necessary. The petroleum industry alone had built up an army of 6,000 research workers.

That's why, by the end of next year, we'll be producing seven times as much aluminum as we made in 1939—enough to build, in one year, three times the number of passenger cars on all American railroads. That's why, with new plants designed to produce magnesium from sea water, we can afford to put half a ton of that light metal into every fighting plane we build. That's why attack gliders and training planes of *wood* are rolling off the production lines right now. With years of experience with synthetic resins, chemists were able to produce phenol formaldehyde binders and finishes to cement layers of wood veneer into a material tougher in proportion to its weight than anything engineers had ever worked with.

NOT alone has the chemist pulled the throttle wide open in his own industry. He has stepped into nearly every other industry with aids to faster and more efficient production. The dry-cleaning fluids that used to clean your best suit are going to war plants now instead. They're used to clean metal surfaces—speeding up plating, lacquering, and painting of those surfaces. With new solvents and a continuous-belt device, chemical engineers have reduced the time needed to bleach cloth for uniforms from 12 hours to two. And now comes the explosive rivet—one of the most fascinating little gadgets ever conceived by the mind of man—putting an end to one of the most serious bottlenecks of plane production with a *bang!*

Of 250,000 rivets in a Flying Fortress, as many as 10,000 may be in awkward places that can be reached from only one side. Today these are fastened with a rivet that has a small charge of explosive in its shank. When the rivet is in place, the charge is set off by heat from an electric gun. Nothing crude about that operation! Chemistry controls the force of that tiny explosion to

within 1/20,000 of an inch! The chemist even plays his part in easing the vital wartime shipping problem. Through working out ways of dehydrating foods without destroying flavor or value, he makes one ship do the work of four in carrying foodstuffs to our allies.

When peace comes, the chemist will slip back into civilian clothes as easily as he slipped into uniform on December 7. Even now he's doing things for civilians every day.

Don't let anyone tell you that, because we can no longer get Asiatic pyrethrum for insecticides, you'll be eaten alive by mosquitoes and gnats when warm weather rolls around again. Chemists have discovered a more deadly insect killer in the thiocyanoacetate of a secondary terpene alcohol, which comes from the pine trees of our own South. And if that should fail to impress your particular brand of houseflies or other pests, they've found a homegrown source of rotenone in a weed that grows in Texas.

Though you can't get copper screening for your windows any more, your chemist will see you through. He's perfected window screens without wire—woven of plastic—and your hardware man will probably have them by next summer. If military needs should call for all the leather we can produce, shoes without leather are ready to fill in the gap.

You can't get chamois skin any more, so how are you going to keep the windows clean? Well, your chemist has found the answer even to that. After just two hours in a new tanning solution of chromic sulphate, sulphuric acid, and sodium silicate, the skin of a plain American sheep turns out to be the best chamois cloth you ever saw!

Does the front porch need painting? Well, by next year your paint worries should be over. There are new pigments to take the place of the zinc needed in war industry; new synthetic resins to double for the natural resins we used to get from Zanzibar, the Congo, and Borneo. And new vegetable oils.

Our paint industry was hard hit when Jap armies swarmed down on the Burma Road, cutting off our biggest source of imported tung oil. War had already dried up the stream of other imported oils needed for the making of paints. But now a chemist has come forward with news that ought to make headlines but will not, because we've grown to take miracles for granted. Starting with our homegrown corn, soybean, or linseed oils, chemists can give us new oils tailor-made to fit any requirements.

The postwar world will be one of abundance. The word "scarcity" will have lost its meaning. There will be enough fertilizer nitrogen to turn every farm into the equivalent of a tropical garden. Out of new materials already developed we shall build homes lighter, airier, better insulated and temperature-controlled, at a fraction of the cost and effort that home-building used to involve. The whole process of producing, storing and shipping the things we eat, wear, and use will be vastly changed for the better.

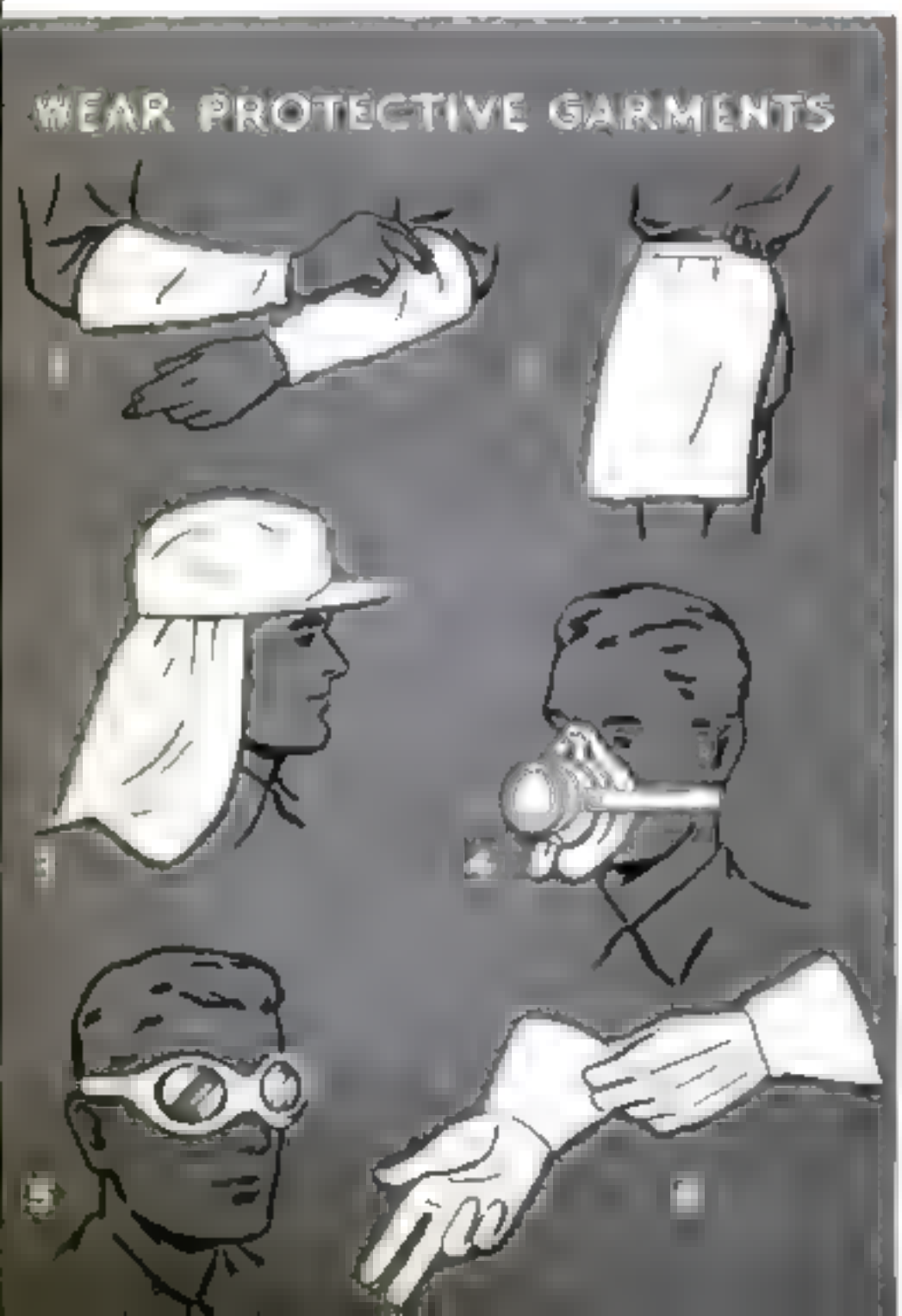
Any preview of that world would be fanciful and distorted. But you can see its beginnings if you watch what chemists are accomplishing in a score of fields that are going to bring a revolution in our ways of living.

Brass buttons have gone the way of brass hats—giving way to plastics. In the photograph, the larger buttons (front and back) are plastic, the smaller ones, brass

How To Keep Your Hands Fit

Keeping the hands and body clean is the best way to guard against skin ailments. Wash your entire body, especially the hands, face, or any other part directly exposed to irritants. Do it as soon as possible after finishing your work, and take plenty of time to do a thorough job and get rid of the irritating substances

WHAT may start as a little skin rash on a worker's hands may be enough to cripple an entire production line. As much as 70 percent of all industrial diseases on our war-materials front may be due to skin ailments. If a worker's hands are irritated or if they swell, he can no longer do precision work; and what this means in slowing plane, tank, or armament manufacture you can readily imagine. Hobbyists at home are exposed to similar hazards. Prevention is much easier than cure. Illustrated are some practical methods for the prevention of the more common industrial skin disorders.



1 Protective sleeves are made from materials impermeable to substances with which you work

2 A split apron guards your thighs against drippings, and permits unhampered movements

3 A dust cap keeps powders out of your hair; a hood keeps them from getting down your neck

4 A mask protects your face from fumes; an inhalator keeps you from breathing them in

5 Shatterproof goggles are a "must" if you do any work where there are flying particles

6 Gloves won't slow up fine work—surgeons wear them. Don't let an irritant get inside

POPULAR SCIENCE

Workers sometimes clean their hands with substances designed to thin paints or to remove grease from machines. Avoid all these cleansers. They are too strong; they dissolve away the natural protective oils and skin fats, and result in dryness, then in cracking and scaling, and finally cause infection

If your work necessitates use of strong solvents replenish the loss of natural fats from your skin by rubbing in an appropriate ointment. A good one consists of equal parts of cold cream and lanolin. If you can't wear protective garments, try using ointments that are water-repellent or oil-resistant

TEN WAYS TO KEEP YOUR SKIN FIT FOR YOUR JOB

1. Keep clean.
2. Take time to clean thoroughly.
3. Don't use a harsh cleanser or abrasive.
4. Use a skin replenisher if needed.
5. See your doctor if infected.
6. Change your clothes after work.
7. Wear protective garments.
8. Keep protective garments clean.
9. Use proper protective ointments.
10. Don't always blame your work.

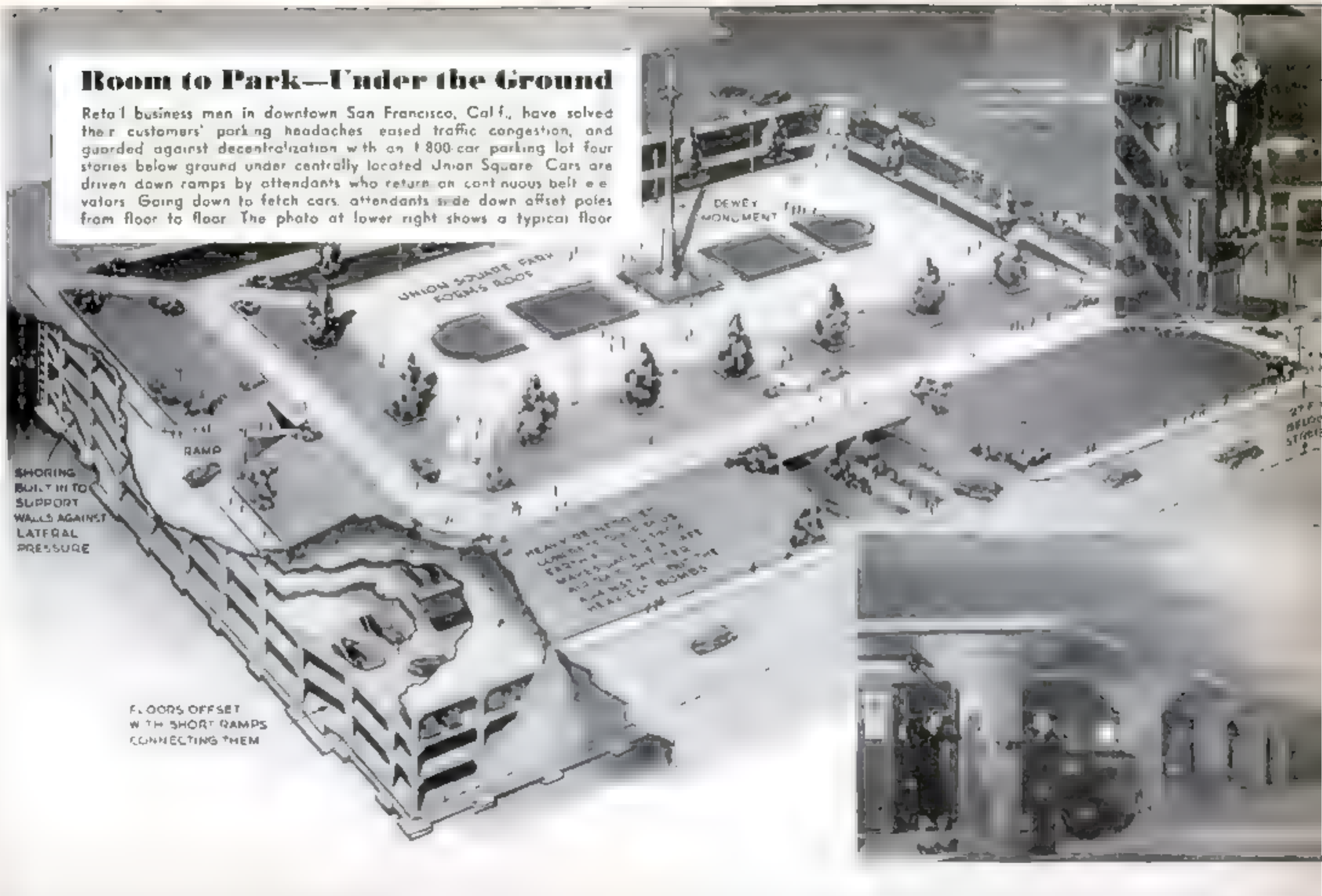
Never pick up a piece of dirty waste from the floor to wipe grease from your hands. It may be hiding pieces of sharp metal that will open the skin to infection, or contain dirty grease that will cause irritation. When you wipe your hands while in the midst of a job, use clean waste or a paper towel

Abrasives like steel wool, wire brushes, or rough pumice stone are too harsh for the human skin, so avoid using them to scrub off paint or grease that does not submit to ordinary cleansers. Better to leave a few smudges than to cut or scrape the skin and leave the way open to later serious infection

If your fingers or hands do become infected despite precautions, go to your doctor. He is an expert on infections and their treatment. Don't trust your own diagnosis, and don't always blame your work. You may have come in contact with poison ivy or "athlete's foot" or contracted some skin disease

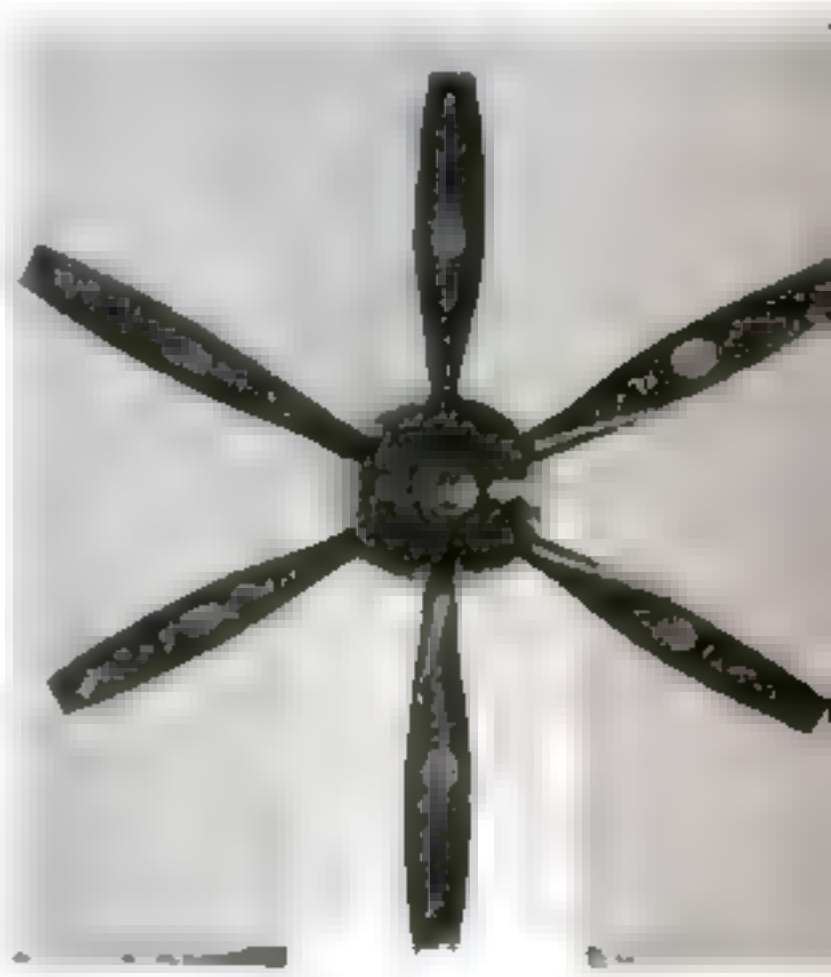
Room to Park—Under the Ground

Retail business men in downtown San Francisco, Calif., have solved their customers' parking headaches, eased traffic congestion, and guarded against decentralization with an 1,800-car parking lot four stories below ground under centrally located Union Square. Cars are driven down ramps by attendants who return on continuous belt elevators. Going down to fetch cars, attendants slide down offset poles from floor to floor. The photo at lower right shows a typical floor



BRITAIN'S MOSQUITO BOMBER, a twin-engined plane which is also used for reconnaissance, and which because of its speed has had unusual success in getting safely in and out of Germany on raids, has now been revealed as being constructed mainly of wood. The use of wood was occasioned by a temporary bottleneck in light-metal materials. Other features of the bomber, which is manufactured by the De Havilland Company, are secret, but it is believed that the plane carries four 20-mm. cannon and four machine guns.

SIX-BLADED, DUAL-ROTATION propellers, designed primarily for planes equipped with 2,000-hp. engines, have been developed by the Curtiss-Wright Corporation, and are being delivered to the U. S. Army for installation on high-altitude fighting planes. The new propeller—which is comprised actually of two propellers mounted one behind the other on coaxial [redacted], each with three hollow, pitch-adjustable blades, and revolving in opposite directions—is the achievement of several years of intensive research. Design engineers estimate that the efficiency of planes having a speed of more than 400 miles an hour will be increased by at least five percent with this dual-rotation propeller, and that its tendency to counteract torque, or twisting effect, will do much to insure the safer operation of single-engine planes. Controls for the propeller are similar to those of the other constant-speed, full-feathering types being manufactured by Curtiss-Wright for high-powered fighters and bombers.



STRATOSPHERE MASKS worn by pilots of Kelly Field are lined with woollike asbestos to protect wearers from both cold and fire. To prevent the noninflammable lens (which might be in one piece, or in two pieces, one for each eye) from becoming fogged by a pilot's breath, the eye space is enclosed with a rubberized cushion. The oxygen tube enters the mask directly under the nose.

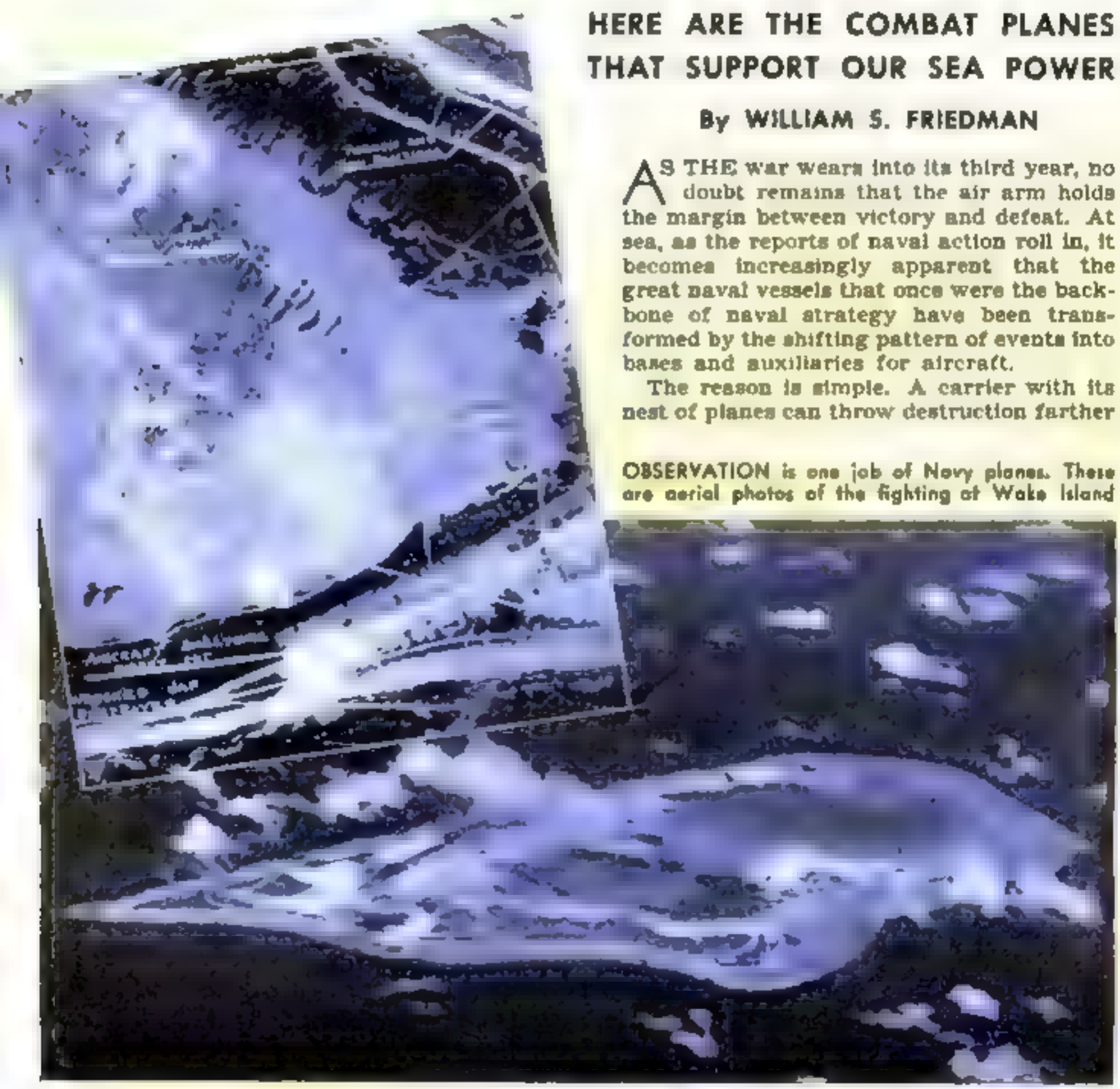
OUR NAVY STRIKES FROM THE SKY

HERE ARE THE COMBAT PLANES THAT SUPPORT OUR SEA POWER

By WILLIAM S. FRIEDMAN

AS THE war wears into its third year, no doubt remains that the air arm holds the margin between victory and defeat. At sea, as the reports of naval action roll in, it becomes increasingly apparent that the great naval vessels that once were the backbone of naval strategy have been transformed by the shifting pattern of events into bases and auxiliaries for aircraft.

The reason is simple. A carrier with its nest of planes can throw destruction farther



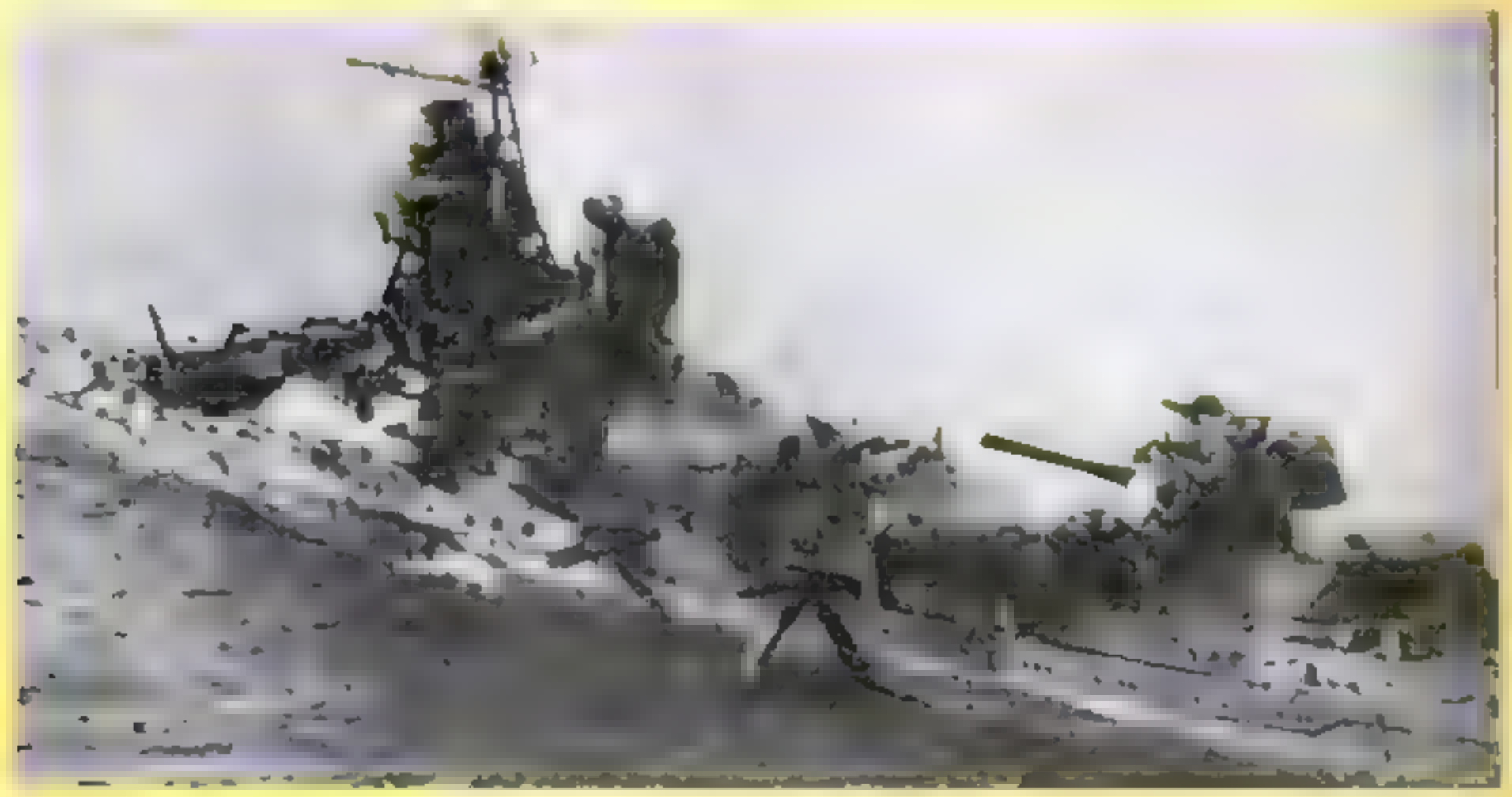
OBSERVATION is one job of Navy planes. These are aerial photos of the fighting at Wake Island

DIVE BOMBERS like the Curtiss Helldiver (SB2C) are taking over the work of the big guns, hauling explosive charges farther and placing them more accurately than the biggest best-manned naval rifles

and faster than the best ship of the line. For pure deadliness, for accuracy and economy of fire, the dive bomber outstrips the big naval gun by a fearful margin. The torpedo-carrying airplane, backed by speed and maneuverability which no surface or sub-surface vessel can claim, scores fewer misses per run-in than even the swift mosquito boats. In modern naval action, the airplane is in turn scouting force, ordnance, defense, and light transport all rolled into one.

The importance to which the air phase of naval warfare has mounted in recent months is best exemplified by a side-light story that has leaked out of the Coral Sea engagement. A complete battle unit, sent out to overhaul and cancel a major Jap carrier, had completed its task. A straggling scout bomber arrived at the flat-top only to find her in flames and listing. No use wasting the valuable missile on her. The pilot scouted for an alternative target and spotted an enemy light cruiser. When the bomb hit, the ship almost tore in half. The pilot then proceeded back to his carrier, bombed up and refueled and went out again on another

This is what one of Japan's crack cruisers looked like when our dive bombers got through with her. On sea as on land, the bomber is tactically a form of artillery



FIGHTERS protect bombers and torpedo planes, and tackle those of the enemy. This is the Vought-Sikorsky Corsair (F4U) Note inverted gull wing and wide propeller arc

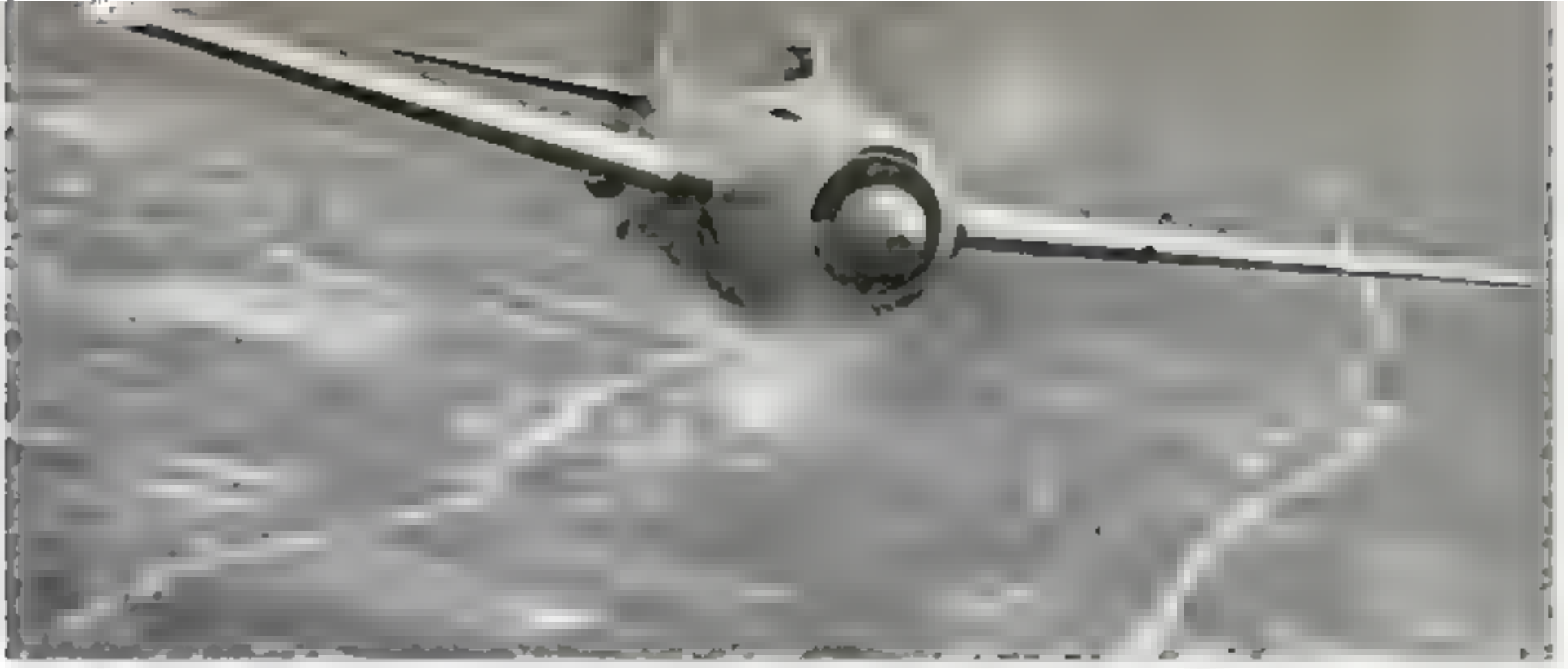
trip. It was not until much later that the sinking of the cruiser came to light. When the check-up was made as to how each bomb was disposed of, the pilot admitted a little apologetically that he had expended the bomb on a mere light cruiser. Since it was a non-airstrength vessel, he deemed it of so little importance that reporting it classed with landing an undersized fish that should have been thrown back. Anything less than a carrier is rated fairly small game.

Running an air navy is a complicated business. Unlike land operations, new and altering conditions have dictated unexpected changes in design requirements for its aircraft and general approach of operations. Naval aircraft are divided into three classes. Before the war, there were only two. First there are shipboard airplanes, the carrier-based fighters, scout-bombers and torpedo-planes; cruisers carry catapult observation craft. In the next class are harbor-based long-range seaplanes; patrol craft and bombers, and far-ranging torpedo carriers by turn. The newest category is that of land-based scout-bombers. This is an innovation gotten from the critiques of the battle of the Coral Sea and from direct experience in anti-submarine patrol.

Early carriers were converted freighters, colliers, and similar makeshifts. Japan's first flat-tops were heavy cruisers with temporary landing decks, created in evasion of the terms of the Washington Conference which limited naval construction. The plan was, when the time for war came, to alter the superstructure, mount heavy guns, and send the ship to sea as a cruiser. It is an odd reflection on the turn of the war to discover that many of the current Jap carriers were originally laid down as cruisers and other craft and hastily converted to swell the carrier tonnage.

Our carriers are stocked with three basic classes of aircraft: fighters, scout-bombers, and torpedo planes. Their functions are simple. The fighter protects the carrier from enemy attack or accompanies the scout-bomber or torpedo plane to its point of attack, fending off the enemy interception. The scout-bomber does some of the scouting, but its chief job is that taken over from the big guns; diving down and accurately planting explosives directly onto enemy objectives — ships, land installations, etc. The torpedo

An occasional ducking is part of the naval flyer's job. Here three men whose plane was shot down are being rescued from a rubber boat



A DUAL-PURPOSE PLANE the Grumman F4F-3 serves as both fighter and light dive bomber. Gives fine performance at high levels. Bombs are carried under wings

plane bears the deadliest marine missile of all, the "tin fish" which it can haul prodigious distances at high speed and carry closer to the objective than any destroyer or PT boat. As a destructive weapon, it can take over one of the destroyer's nastiest jobs, completing it for a great deal less investment in equipment and risking a smaller crew. The torpedo unit-casualty score between the four usual torpedo media—the submarine, destroyer, mosquito boat, and plane—gives the plane a fairly wide margin when operating against armed surface craft. Several things are in the plane's favor. First there are fewer men (three) involved in a torpedo-plane attempt. The plane is the smallest target, moving at a far greater speed. Both the destroyer and the torpedo boat have one dimension of fire fixed; they must be on the surface. The submarine and the airplane alone may operate at a multitude of levels and angles, in a three-dimensional battleground. The sub is definitely limited as to the depth at which it can move in its medium and has a speed inferior to most of its targets.

Most cruisers and carriers also carry a few light, low-powered, far-ranging scout observation planes such as the Curtiss Seagull and the Vought-Sikorsky Kingfisher, either on wheels for straight deckboard operation or on a single float, to be catapulted off for fire correction for a cruiser's guns. The type's low power and light armament make them so vulnerable that many naval authorities discount them, and often their duties are transferred to ships better capable of combat.

Carrier planes are, at present, in the process of transition. Changes in naval types have necessarily been slower than in those operated from land bases. To begin with, types are changed in response to known needs, actually shown in battle. Because Japan was the first enemy to come out with any appreciable carrier strength, major replacements had to be made only after the facts were known. For the most part, our types had adequate performance to hold the enemy. The changes are made so that we can not only keep ahead of him, but boost performance by a large enough margin so that we can positively and finally wrest control of the air over the sea lanes. The remainder will then be a fairly simple military operation.

Our Navy went into the war with three basic deckboard types. One was the Grumman F4F, affectionately known as the Wildcat. It was a nasty, stubby little airplane with a 38-foot wing span. It weighed a bit over 5,700 pounds, its top speed was above 340 miles per hour. It was armed with four .50 caliber machine guns and hauled enough gas to take it 1,100 miles.

It is a mistake to compare such performance with that of the Hurricane, Spitfire, Warhawk, and other fast land-based fighters. Shipboard-aircraft design is limited by certain factors which do not affect the land-based fighter. The entire landing area for the shipboard fighter is the carrier deck —300 yards long at the most. The fighter must be off in a fraction of that. The fighter's dimensions are limited by the elevator facilities on existing carriers. Its range must be almost as great as that of the dive bombers and torpedo planes it is destined to escort.

The shipboard fighter must have superior maneuverability. In land fighting, it is possible for the attacking plane to make a single pass at the enemy, but the carrier ship must stay and fight. In the first place, there are only a limited number of fighters available. If the *(Continued on page 73)*

NAVY'S AIR BACKBONE These 10 planes represent the basic types now in Navy combat operation. Not included are the scout-observation types such as the Curtiss Seagull, the Vought-Sikorsky Kingfisher, and the newest acquisitions from the Army—the Boeing Flying Fortress and Consolidated Liberator, both four-engined craft to be used for shore-based patrol-bomber work. Some of these 10 planes are being replaced by new and deadlier types, but each of them has proved itself more than a match for the comparable enemy craft

PBY Seven-place patrol bomber. Basic design is almost 10 years old. Has done yeoman service for our Navy and the British. It was a plane of this type that found the Bismarck

PB2Y Four-engined flying boat. Nine to 12 place, protected by seven guns. Has a long range and can be serviced in deep water. Span is 115 feet, service ceiling 18 000 feet

PBM Newest patrol-boat type. Gull wings and inboard placement of retractable wing floats permit landings in rougher seas than are possible ordinarily with such big boats

PBO First land type patrol bomber adopted by the Navy. Wide speed range makes it death to submarines, enabling it to get over them fast, then slow nearly to stalling speed

F4F The standard fighter with which the Navy went to war. Has downed plenty of Zeros, Messerschmitts, and Italian Reggianne Falcos. It helped in the epic defense of Malta

F4U Replacing the doughty Wildcat. Its inverted gull wing gives it aeronautical and operational advantages. With high speed and fast climb, it is remarkably slow in landing

SBD Big gun of the carriers, this scout-dive bomber has accounted for more tonnage than all the heavy ordnance. Being replaced by the faster, heavier-loaded Helldiver SB2C

SB2C This new dive bomber hauls enough explosives to cripple any vessel afloat. Its top speed puts it in the pursuit class, and it is armed to take care of any single-seater

TBD First monoplane to be operated from a carrier. Tops in torpedo planes until the Avenger came along. Carries a 21-inch "tin fish" semi-exposed. It has served since 1936

TBF The versatile Avenger carries bombs, depth charges, or torpedo concealed. Fast and maneuverable, it has a range exceeding that of any other carrier-borne torpedo plane

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Foldout slip-sheet

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2. Insert this sheet with
    1. Front side touching the foldout page
    2. Arrow pointing to the fold
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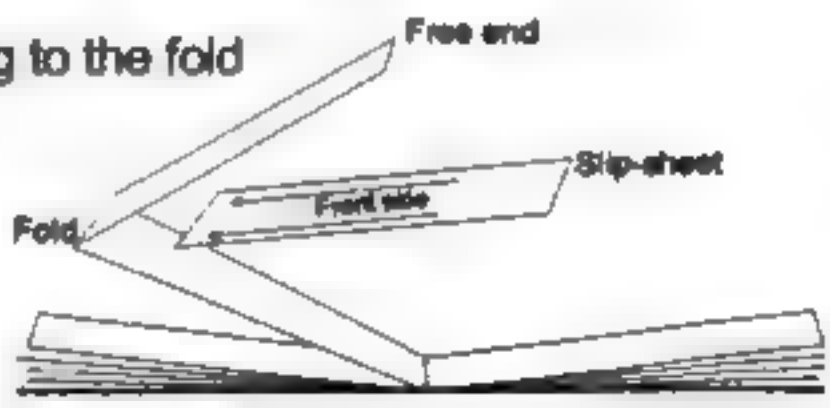

1. Follow instructions on the other side

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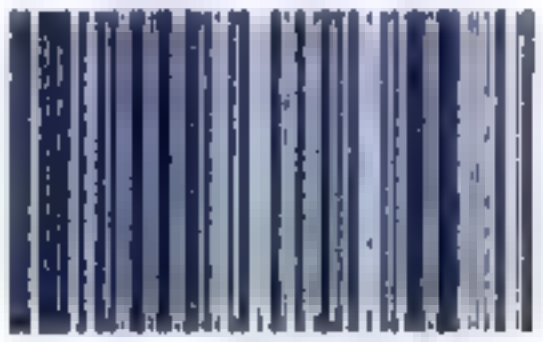

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Back

1. Follow instructions on the other side

THE AVENGER (Grumman TBF) has been living up to its name ever since it got its baptism of fire at Midway. Deadliest carrier-based torpedo plane in the world today, it carries a full-size, 2,000-pound naval torpedo or a similar weight in bombs. Since its load is concealed by swinging covers, it keeps the enemy guessing as to what kind of attack to expect. It has already chalked up a high score in enemy vessels sunk and damaged. *POPULAR SCIENCE MONTHLY*

SHORE-BASED CRAFT include both flying boats and land planes. The former range from the Martin Mariner (PBM) through the Catalina (PBY) to the big four-motored Coronado (PB2Y). Land planes are the Lockheed Ventura (PBO) and the Consolidated Liberator (PB4Y), soon to be joined by the Boeing Flying Fortress. Flying boats have certain operational advantages; their worst fault, the "blind spot" created by the hull, may be overcome. Use of long-range land-based planes is growing fast

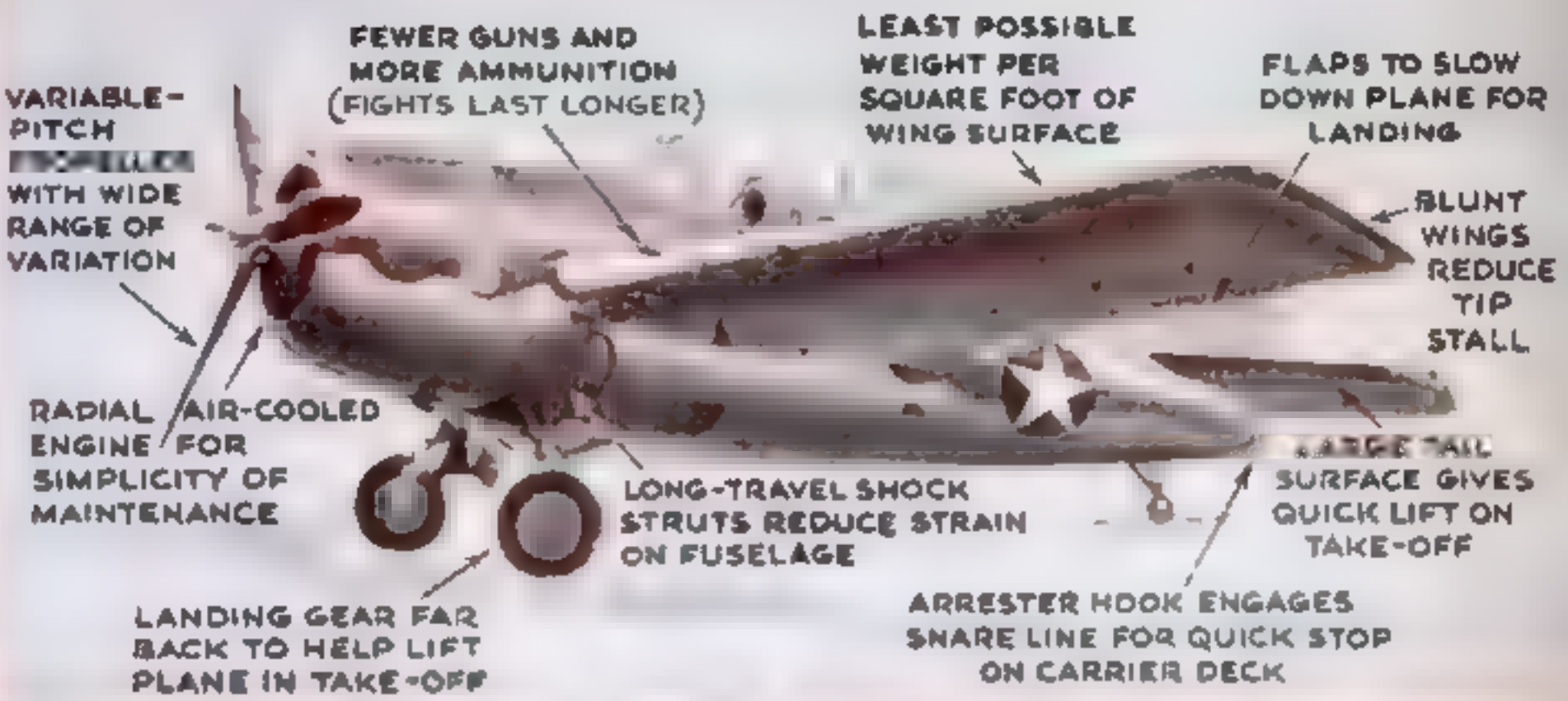
fighter lets the enemy get by, he is likely to have no carrier left to land on.

The gun-ammunition ratio in a naval fighter is different from that of a land plane. The average Army job calls for a major weight investment in gun power for a withering blast at the enemy, enough to make the ship disintegrate. However, the ammunition allows only a short duration of fire. This is based on the patrol system upon which land fighting is predicated—the availability of large numbers of airplanes so that if an enemy force resists or evades one blast, other ships can be sent to intercept it. The carrier goes to sea with a definite number of planes and replacements; additions or reinforcements are simply unavailable. In the carrier fighter, fewer guns are mounted, most of the fighting weight being invested in ammunition. In a concentrated naval action, a Wildcat is likely to be attacked several times. Therefore, being able to sustain fire is vital. This puts great stress on the quality of marksmanship

There is a widespread belief that deck-board fighters land much more slowly than land-based pursuits. Actually, this is not true. Having more room to land in, the land-based Army fighter pilot can bring his ship in on power, flying it parallel with the field and settling slowly, losing the last of his flying speed close to the ground. The Navy fighter, on the other hand, has a fraction of a moving quarter-acre deck to sit down on. Each landing must be "full stall," that is, the ship must be brought in slowly and, by the time the wheels touch the deck, the wings must be devoid of lift. This requires great lateral control at slow speeds. This need, combined with the demand for as much wing area for the span as is possible, produces the stubby, square-tipped wing that has made the Wildcat one of the most popular types ever *(Continued on page 76)*


THE WILDCAT
THE CORSAIR
THE DEVASTATOR

COMMON CHARACTERISTICS OF CARRIER-BASED PLANES



stocked for deckboard use. Even the British admit that the F4F—or Martlet, as they call it in the Fleet Air Arm—is among the hottest craft that ever dropped an arrester hook on His Majesty's carriers.

The Wildcat, excellent as it is, must be replaced. Carrier action in amphibious warfare often dictates that the deck-board fighter meet land-based fighters or intercept high-altitude bombers. The next ship in line seems to be the Vought-Sikorsky F4U-1, the Corsair. A little bigger than the Wildcat, it weighs almost twice as much, carries more guns, and sustains a longer rate of fire. Its 2,000-hp. engine provides it a phenomenal climb and a service ceiling closely approximating that of the best-known land-based fighter craft. Most figures on the Corsair are under restriction, but is safe to say that total replacement of the older type will be possible soon. There are several other nasty surprises scheduled for the enemy. One of them has acquired the affectionate nickname of "the big beast," and the early reports on its performance indicate that it is turning out to be a terror.

Scout Bombers are the big guns of the modern air fleet. Fast, quick-in-quick-out ships, their job is to power-dive in at as steep an angle as they dare. The diving sight is the same instrument that is used to direct the ship's forward fixed guns. The technique of dive bombing has altered considerably since the Navy first demonstrated it over ten years ago. Originally, the pilot merely glued his sight on the target and dived the ship dead on, pulling out at as close an altitude as he considered safe. The first dive bombers were wire-and-strut biplanes, and their parasite resistance kept the airplane from gathering an uncontrollable amount of speed.

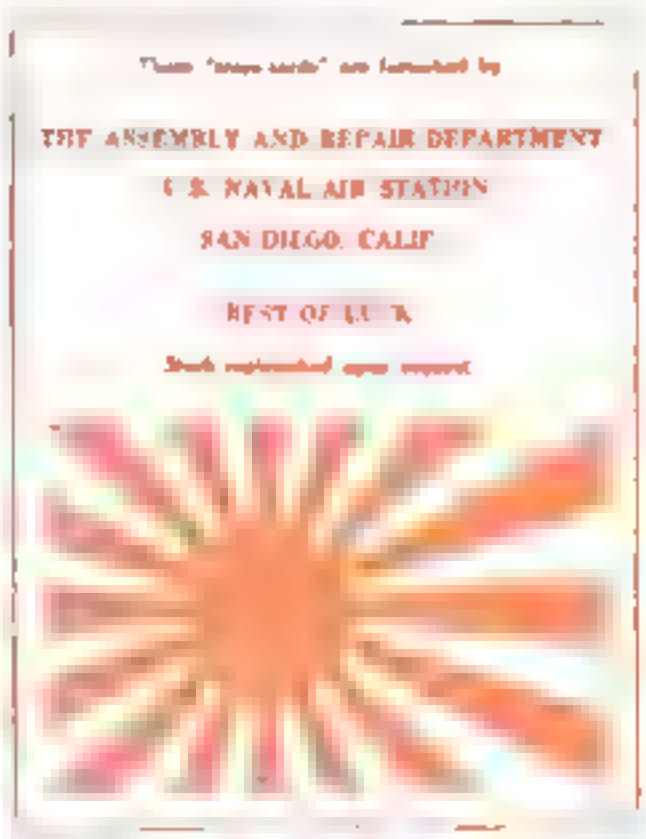
Since that time, anti-aircraft tactics have been improved, so that a pilot attempting the old-fashioned straight bombing dive would be a dead duck and even the high speed of his ship would be little protection. The modern dive bomber is an exceptionally clean airplane, and uncontrolled diving would permit the accumulation of more speed than is necessary or useful. To control this excess speed in a dive, air brakes are employed. The popular U. S. design is a double perforated flap at the trailing edge of the wing which sweeps both up and down, increasing the resistance and decelerating the airplane. The old-fashioned direct dive has been changed to circuitous approach patterns which are highly varied and often completely unpredictable. As the bombs that the dive bomber carries increase in size, it becomes necessary to release them at a higher altitude to prevent their explosion from wrecking the plane as well as the target.

The currently used craft is the Douglas "Dauntless," which hauls a single 500-pound bomb 1,000 miles at a speed exceeding 250 miles per hour. The Dauntless has an unequaled record in the Pacific. It was in this type that the immortal Lieutenant Powers "laid one on the deck" of a Jap battlewagon, carrying it to less than 500 feet and going down with his victim.

Oddly enough, the Dauntless is being replaced, not because it could not do its job, but because it was so successful that it proved for all time that dive bombers could be trusted with practically every job ever given to a full naval gun. The only thing it lacked was the heavy-weight missile. The Curtiss Helldiver, the SB2C, built to haul four times the Dauntless's bomb weight for 1,200 miles at a greater speed, is now swinging into full production. This type is capable of sinking almost any vessel afloat all by itself. Armed more heavily than its predecessor, it can, if necessary, fly to an objective with a minimum of fighter support. In the Dauntless, the bombs stowed externally, causing considerable parasite resistance in the air. The speed difference, checked again actual tests, indicated a 15-m.p.h. difference without the bombs. As a check, 500 pounds of dead weight were stowed inside for the comparative run. In the Helldiver, the bombs are stowed internally.

Unless you count the helpless cargo craft sunk by submarines, the torpedo plane is tops in the sinking of war tonnage. So far, the only sure cure for the torpedo plane is the fighter. Until recently our fleet has been equipped with the TBD, the old Douglas Devas-

(Continued on page 233)



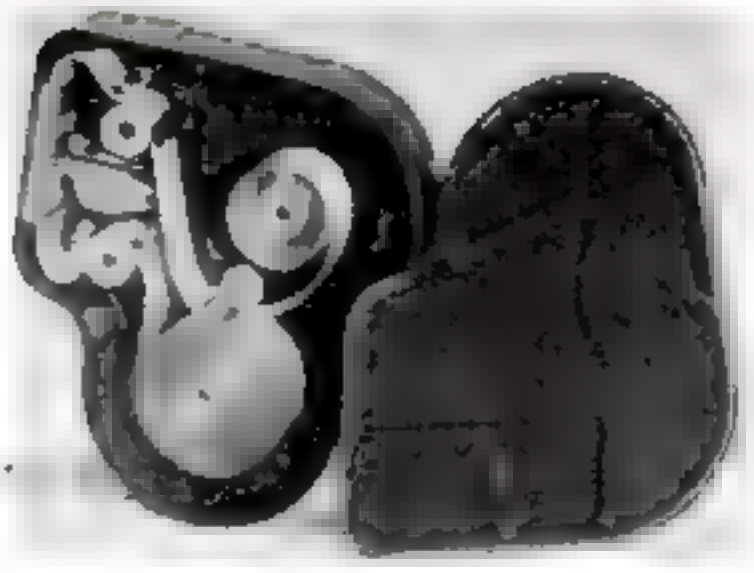
"SCORE CARDS" for Navy flyers are supplied in envelopes like this. They are Rising Sun decalcomanias to stick on planes, chalking up victories over Japs. Quality of our Navy planes and pilots assures steadily growing demand

AIR FREIGHT of any kind is held firmly in cargo planes by hold-down equipment designed by the Evans Products Company. One method, illustrated above, uses longitudinal members permanently attached to the roof and floor of the plane. These are supplemented by adjustable posts to which transverse members are anchored.

HEATING ELEMENTS insulated with braided fiber glass are now available in any length. Highly flexible, the material can be packed snugly about parts to be heated, or jammed into tight spots. It will also serve for flexible power resistors.

A WORLD HIGHWAY and air route, girdling the globe from Buenos Aires to the English Channel, is proposed by Vice President Henry A. Wallace for construction after the war. Important links would be the Pan-American Highway, now under construction, and the recently completed Canadian-Alaskan Military Highway (See page 99).

Held against the shoulder like a submachine gun, this camera films fast action. Batteries in the belt case supply current



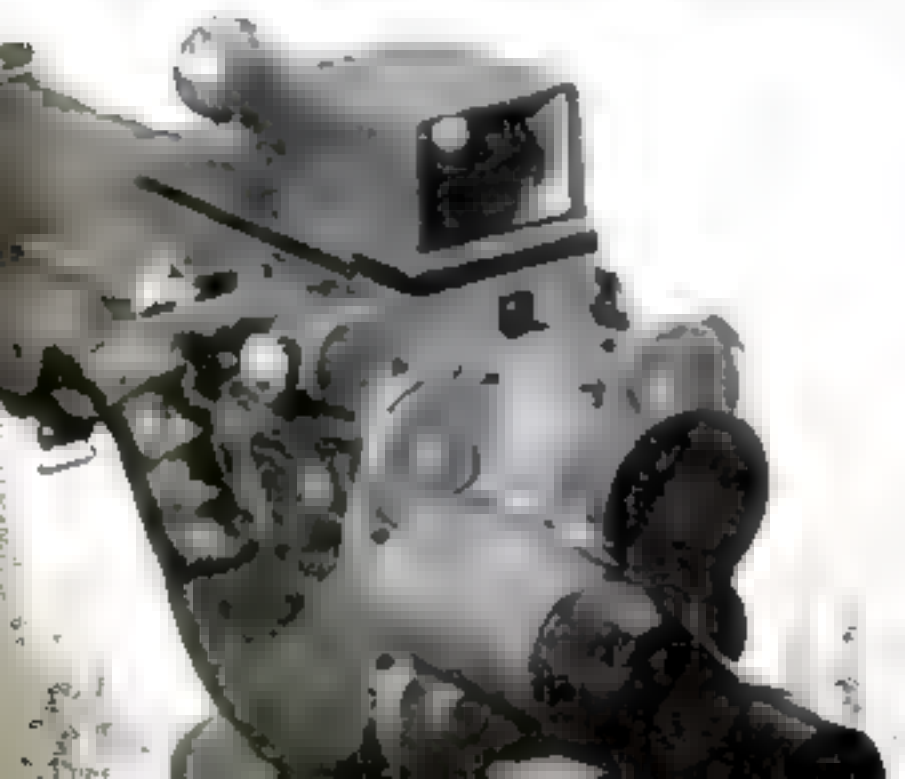
How film looks in the magazine. It is loaded in the field in a changing bag

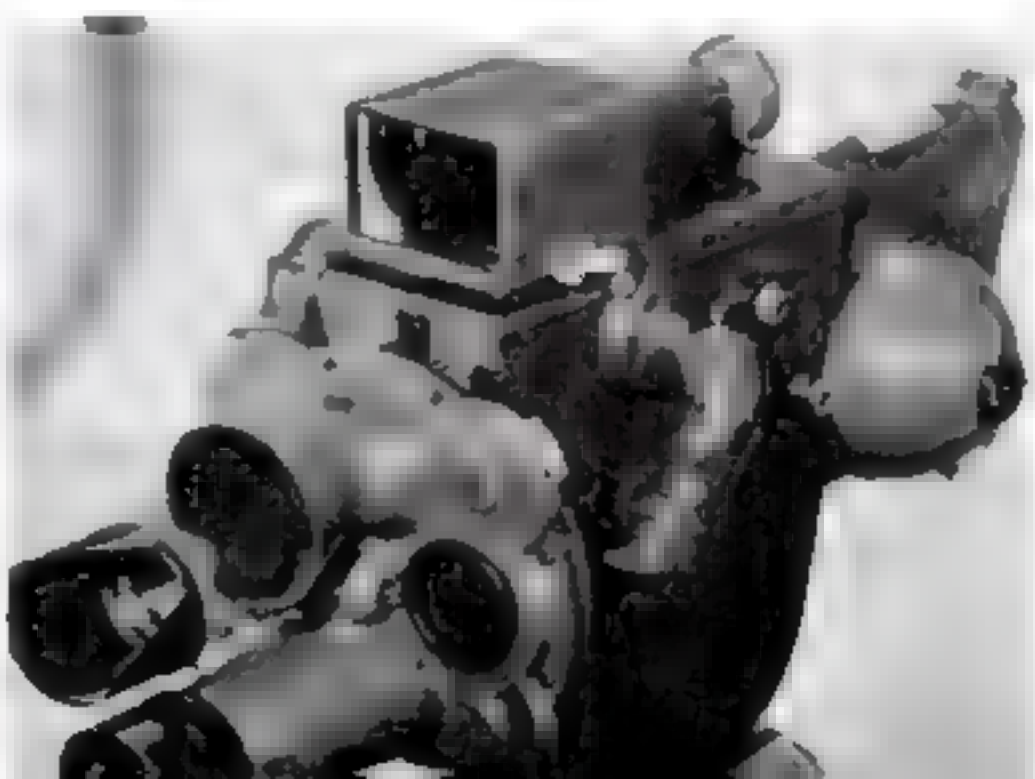
Pistol-Grip Camera Shoots Battle Scenes

DESIGNED for filming land, sea, and air battles, this combat movie camera is equipped with a gunstock support and two-handed pistol grip. It is aimed and handled like a submachine gun, and although it can be set up on a tripod, it is intended for hand-held operation. The original camera built by Harry Cunningham, Hollywood cameraman, uses 35-millimeter film and has a 200-foot magazine, but those in production will take 16-millimeter film. The magazine may be loaded in the open through use of a changing bag. Two small "B" batteries clipped to the belt supply current for the motor.

Three speeds, 16, 24, and 48 frames a second, and four lenses, 35 and 75 millimeters and six and 10 inches, film all types of action. Each lens has its own finger-operated diaphragm control. Film and magazine are racked in or out for focusing by a control near the right-hand grip. Two small levers move supplementary optics into place for telephoto lens fields.

Below, right and left-hand views of the camera, showing lenses, pistol grips, and controls . . . . . The view finder swings aside to permit insertion of the magazine. Loaded, the camera weighs 13 pounds

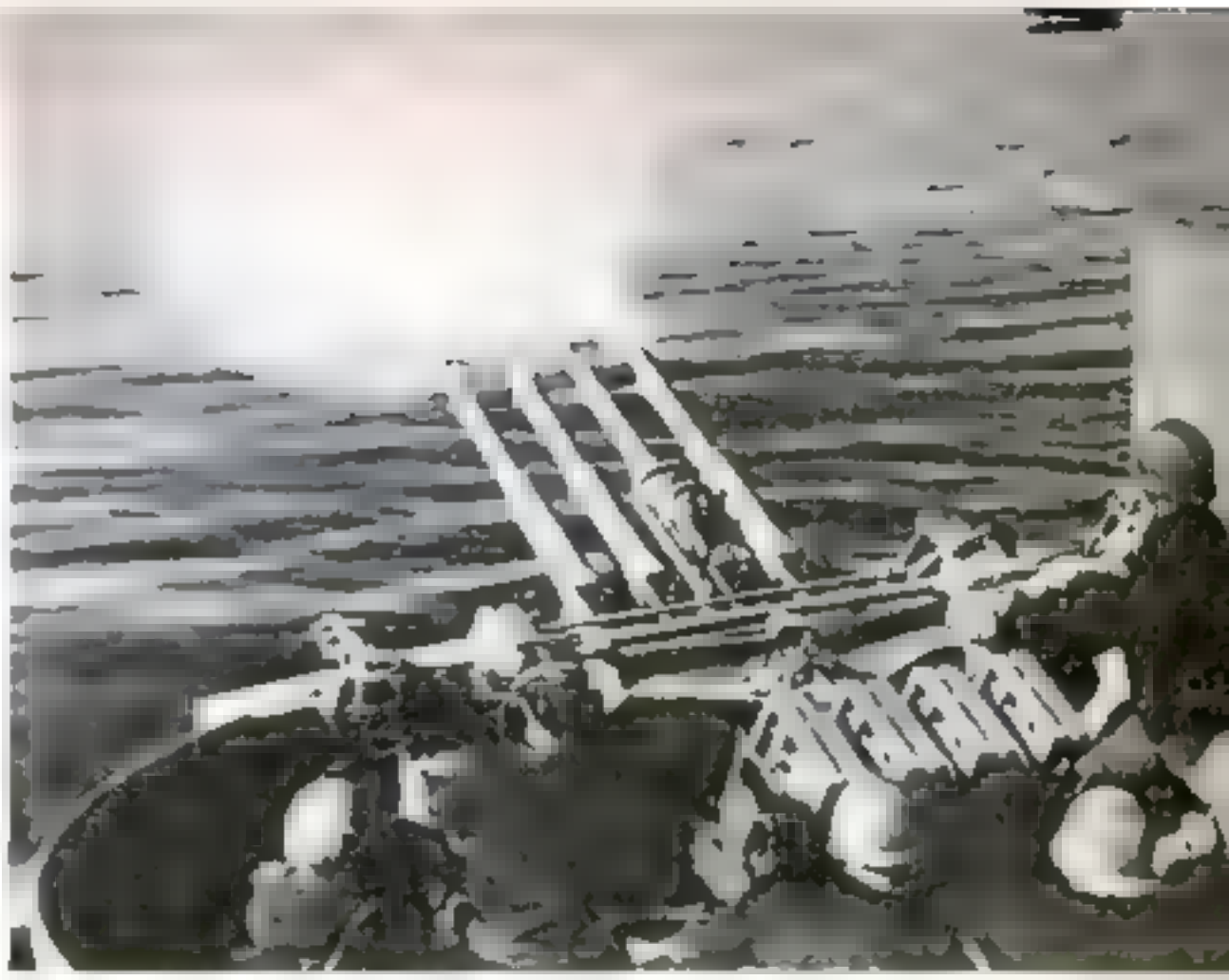




Mounts for the Navy's 1.1 AA Guns

ASSEMBLY-LINE methods applied to the manufacture of mounts for 1.1-inch Navy rapid-fire antiaircraft guns resulted in a saving of about 6,400 man-hours of labor and about $15,000 in cost for each mount, it was announced recently on the completion of a Navy contract by the Westinghouse Electric Elevator Company.

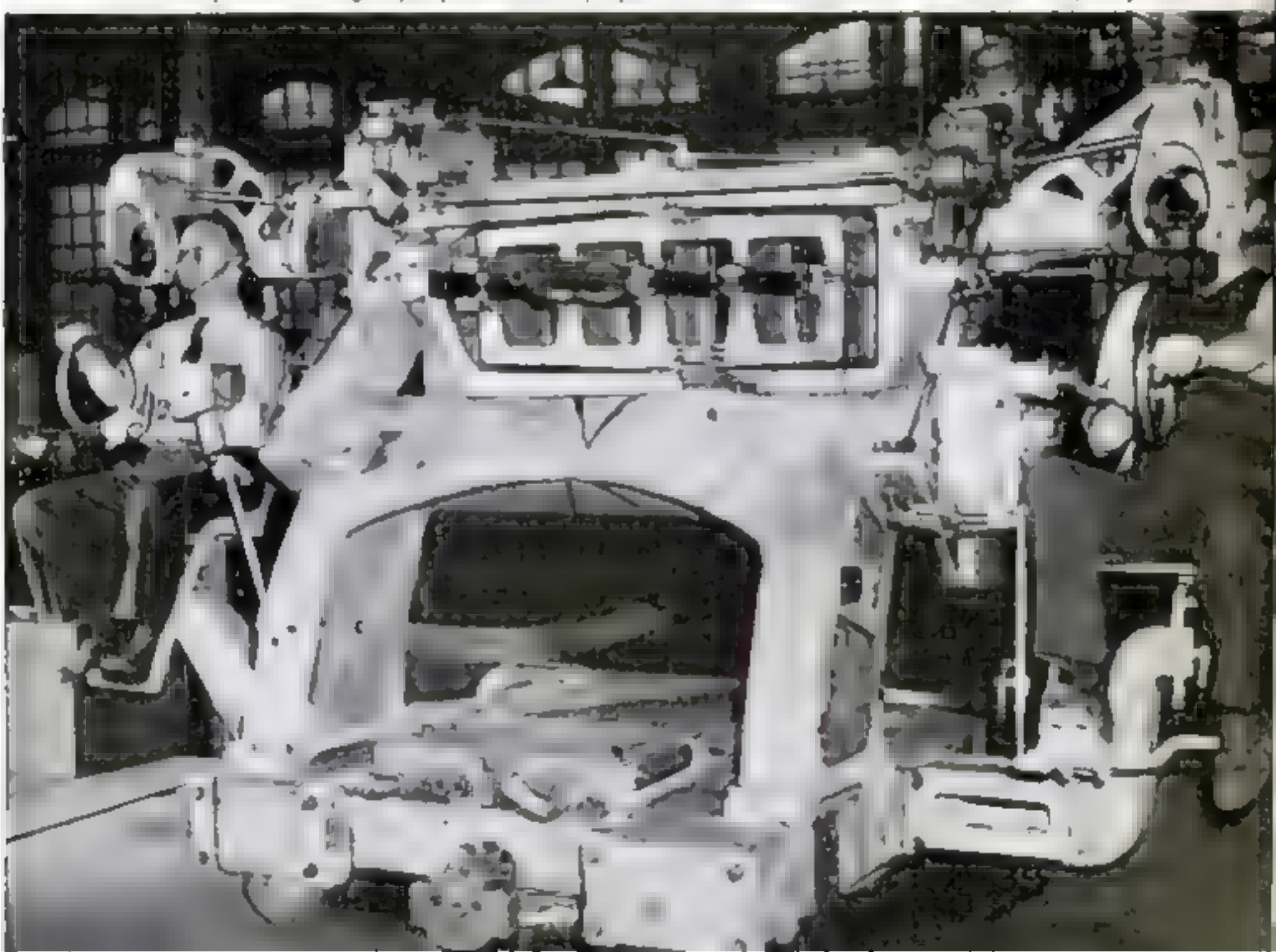
Affectionately called the "Chicago piano" by the British, the 1.1 multiple pom-pom has served our Navy with distinction in every major engagement since Pearl Harbor. Four water-cooled barrels set in the H-shaped 14,000 pound mount are aimed by two gunners on opposite sides and fired in almost simultaneous bursts by a trigger mechanism. Aiming may be either manual or by hydraulic power. The mount will swing in a full circle



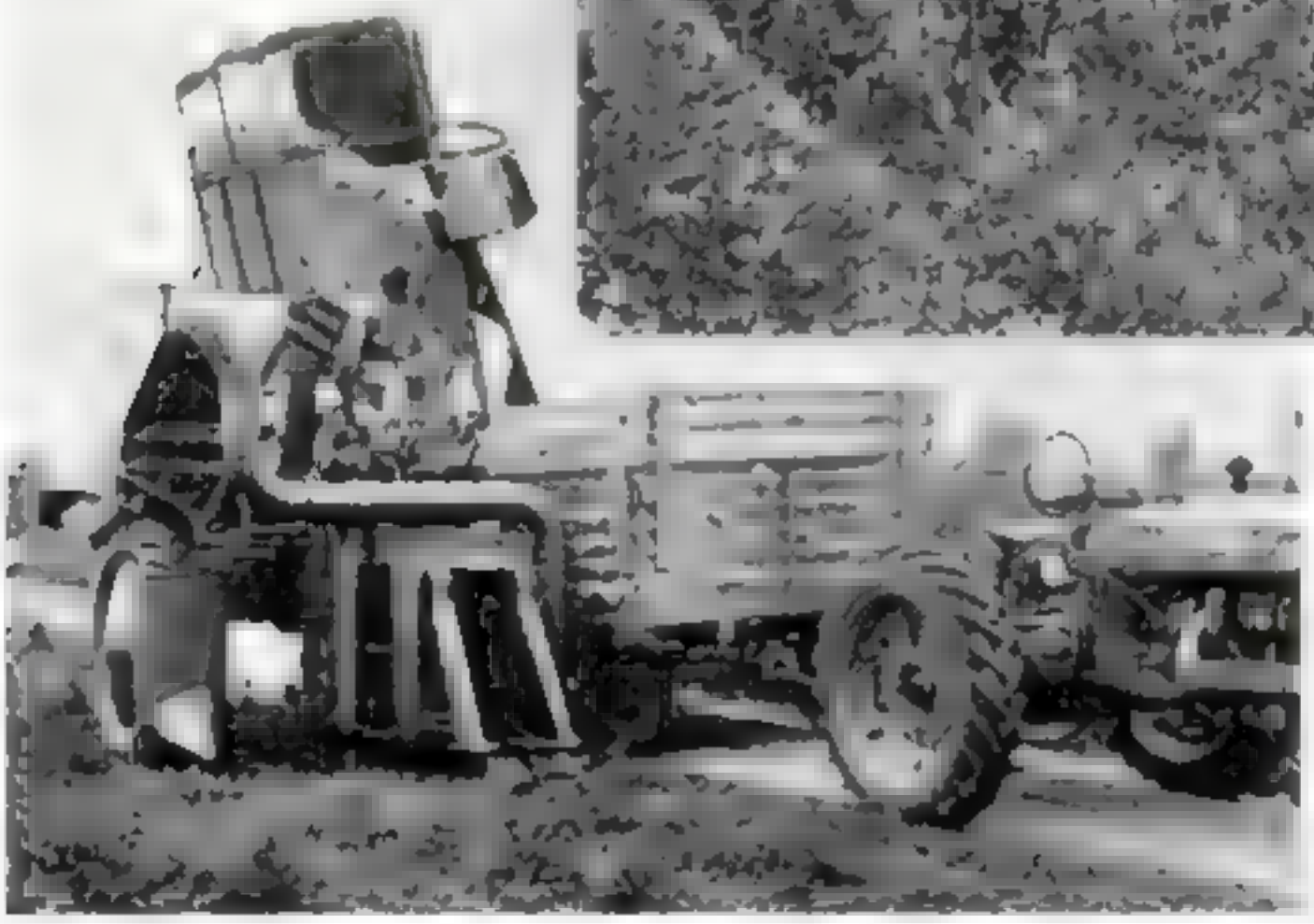
Playing a tune on the "Chicago piano." This multiple-barreled naval antiaircraft gun has winged plenty of Japanese bombers

Record-breaking production of the mounts by the elevator builders called for precision manufacturing to tolerances as small as 1/20 of the thickness of a sheet of newspaper. Accuracy was assured by 4,800 inspections during the manufacturing process—about six for each of the principal parts.

Factory inspectors testing alignment of sights on a 1.1-inch gun mount. Maximum allowable tolerance is a minute (1/60 of a degree), equivalent to a projectile deviation of less than 10 inches in 1,000 yards



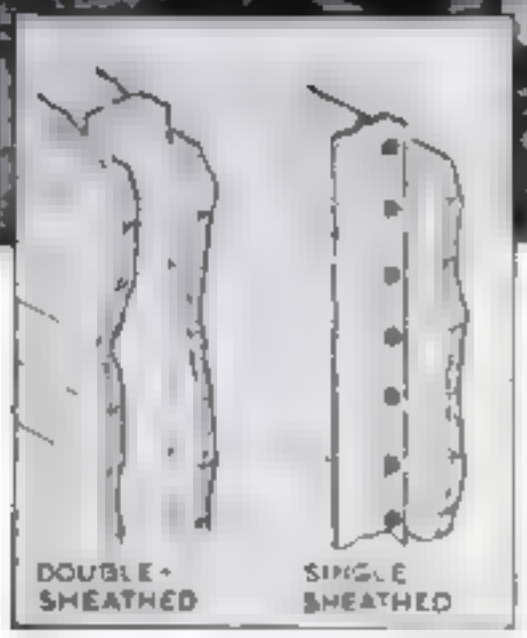
MECHANICAL COTTON PICKERS may prove an important factor in relieving wartime labor shortages. After 40 years of experimenting, the International Harvester Company announces that it has perfected a machine which will pick cotton profitably under conditions prevailing in the principal cotton-growing areas of the United States. Tests have shown that one of these machines, requiring only one man to operate it, will pick as much cotton in one day as 50 to 80 hand pickers. The only drawback is that the cotton requires a special ginning process.



Fowler McCormick, president of International Harvester, driving an experimental cotton picker in a Mississippi field

Dumping cotton from the wire-netting basket of the machine into a trailer which hauls it to the gin

ALMOST UNBREAKABLE PENCILS are said to be the result of a new manufacturing process which achieves a complete fusion between the graphite "lead" and the wood in which it is incased. This fusion makes the strength of the point dependent upon the entire unit leverage, rather than upon only the combined strength of the lead and the thin shell of wood that surrounds it when the pencil is sharpened. Not only is the lead of the new pencil more resistant to writing pressure, but the pencil itself is harder to break. Another innovation in this product of the Reliance Pencil Corporation is the use of plastic for the ferrule that holds the eraser. Besides saving brass needed for the war effort, the plastic ferrule comes as a long-awaited boon to all pencil chewers—for it is both tasteless and harmless.

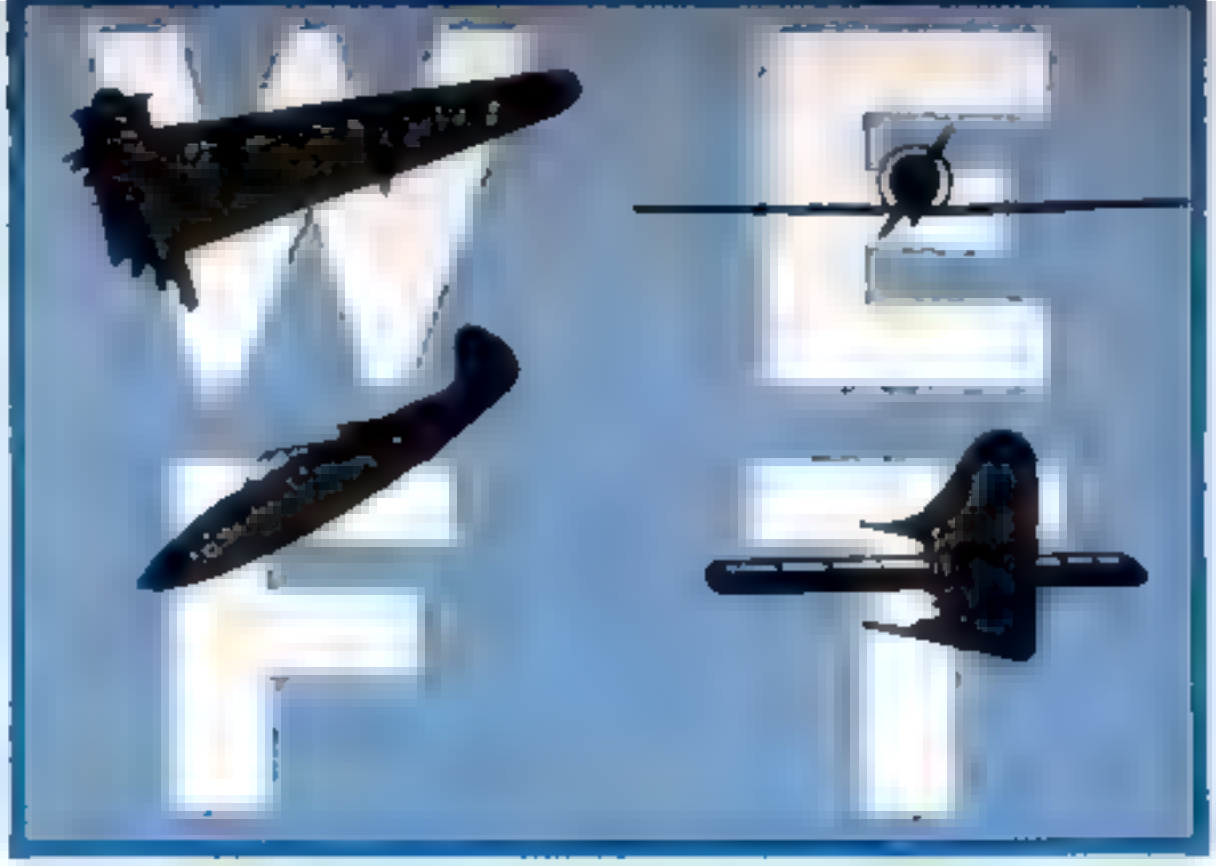


PRESSURE-TREATED LUMBER is now being used in freight cars to permit single-sheathed construction. With this type of wood, delivered prefabricated in another departure from custom, adequate protection is given to cargoes, the additional strength of outside sheathing is found unnecessary, and the material saved is considerable. Treatment is said also to reduce losses from termites and decay suffered in some sections of the country.

AIRPORT REPAIRS and road patches can be compacted quickly with this new highway roller equipped with pneumatic-tired wheels for trailing behind a truck at any speed. Transition from trailer to roller is made at the scene of repair without jacking, a hydraulic lift being used to lower the main roller to the roadway and raise the trailer wheels out of the way. In addition, the tire and wheel on either side may be taken off completely when work is to be done close to curbings or other obstructions. For ease in steering, the front roller is constructed in two parts, or split. Pressure on the roadway from both front and main rollers is said to equal that of many five-ton machines of conventional design.

Army Shows the Spotter What to See

AIRCRAFT DESIGNS EASY TO IDENTIFY WHEN BROKEN DOWN INTO MAIN PARTS



KNOWN as "WEFT" from the initials of the words "wing," "engine," "fuselage," and "tail," this system of identifying planes in the air simplifies a problem that had grown complicated with the development of a vast number of different aircraft designs.

The WEFT system emphasizes the parts a spotter can most readily see, recognize, and describe—the particular features and shapes characteristic of certain planes and types. From the combination, the nationality can often be determined, even when insignia are

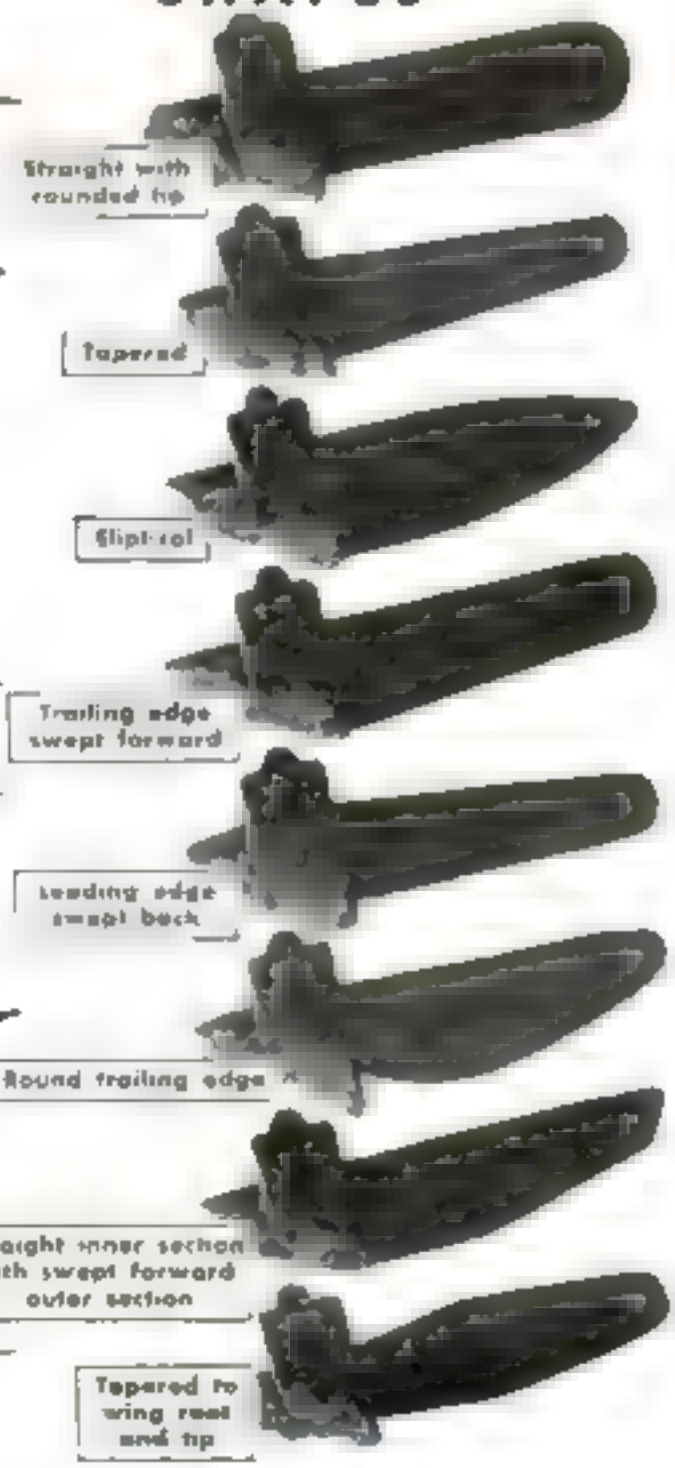
AIRCRAFT RECOGNITION IS EASY

WING details vary greatly in planes, but they sum up into two essentials—type, or position, and shape. The examples here are average for all nations. Those opposite each other are not necessarily matched

ENGINE characteristics are a bit simpler with two general types—radial and in-line. Numbers range from one to four, and their position on the wings may vary considerably, as the chart below indicates

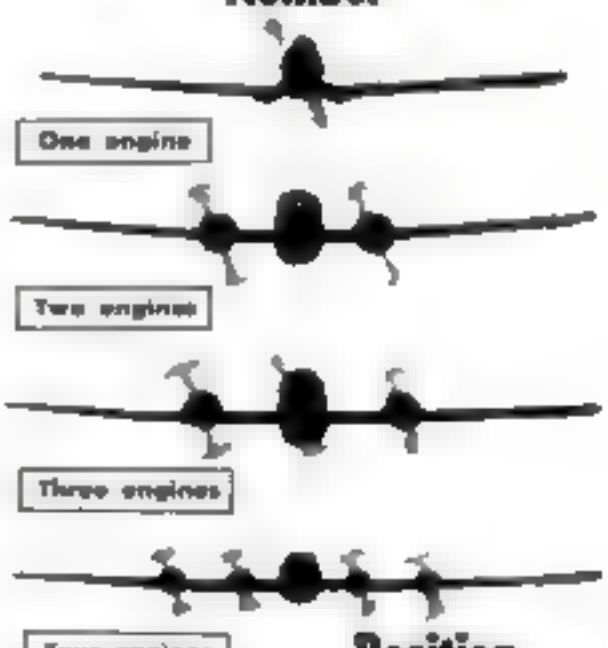
TYPES

SHAPES

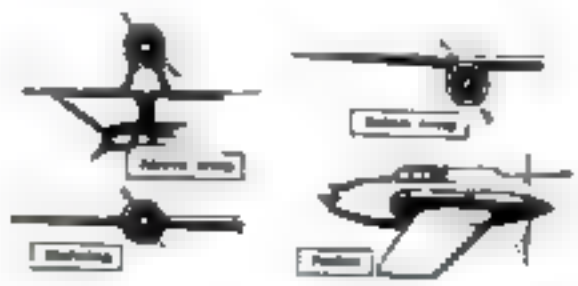


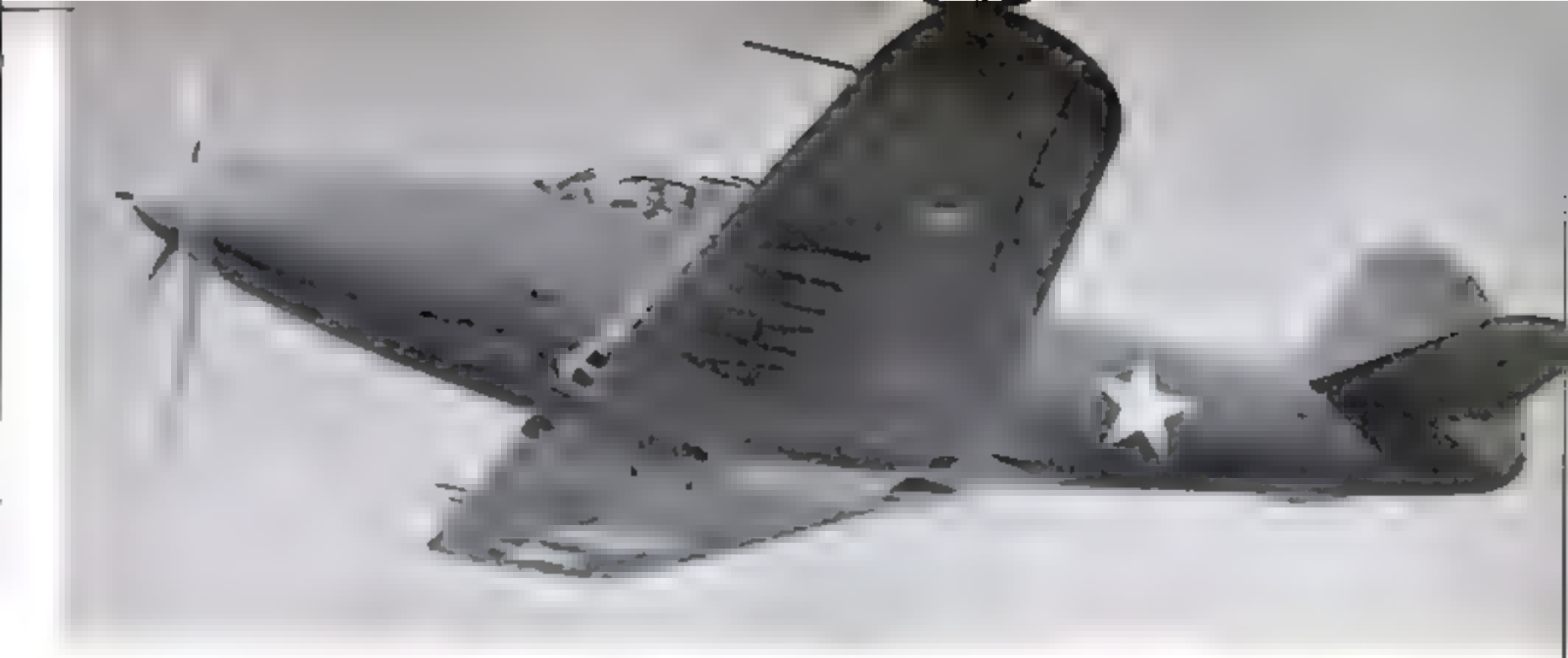
TYPES

Number



Position





not clear, and also the type and distance of the plane from its base, giving a clew to possible additional forces.

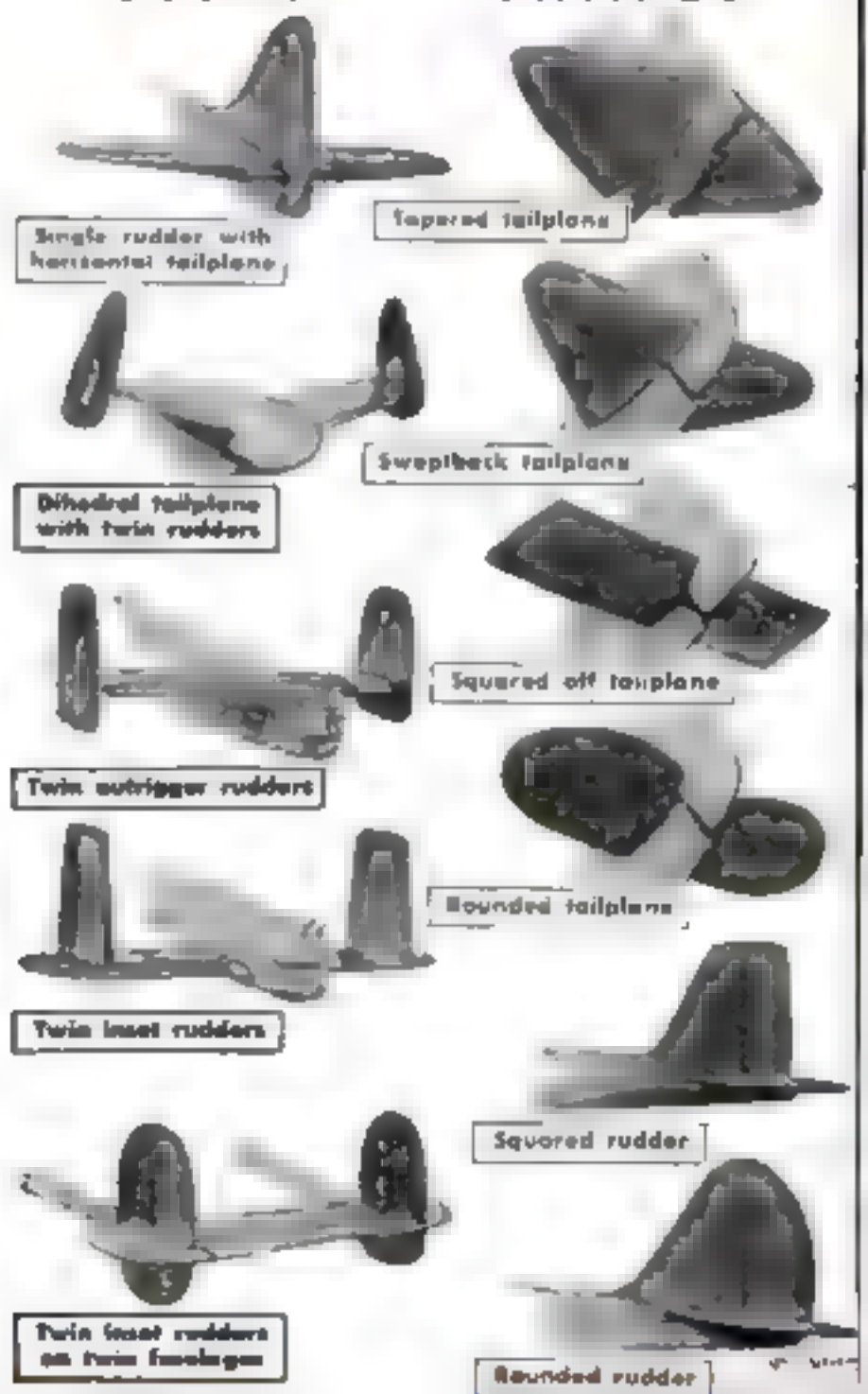
For example, the plane above has a tapered, low *Wing*, single *Engine*, pursuit *Fuselage*, and single-rudder, horizontal-tailplane *Tail*. It is a U. S. Army P-39, the Bell Airacobra.

A number of features are shown below—not all, but averages found in aircraft of all nations. *Illustrations reprinted from the Army Orientation Course chart.*

WITH THE FOUR-STRIP WEFT SYSTEM

FUSELAGE construction is of several types and shapes, from the small fighters to the larger medium and heavy bombers. Some have other marks that can be seen, such as landing gear or turrets

TAIL designs are also a help to spotters. The number of rudders and set of the tailplane are important points to be differentiated. Both rudders and tailplanes can be easily distinguished as well by their shapes



1 From artist's original design plaster replicas are made of the Jefferson nickel

2 Electrotype of the coin's reverse, and bottom, a master die

Photos for Popular Science by Herman W. Hansen

Nickels Without

WITH the new nickel-less Jefferson nickel, the Bureau of the Mint has now solved the problem of how to conserve that metal so precious to war needs. In 1941, 500 tons of nickel were used in producing five-cent pieces which were required by law to contain 25 percent nickel and 75 percent copper. But with the coming of Pearl Harbor, Congress promptly enacted a new coinage law, and since October of last year, the Government's mints at Philadelphia, Denver, and San Francisco have been producing at full capacity a paradox nickel containing 35 percent silver, 56 percent copper, and 9 percent manganese.

Perhaps the best place to watch the interesting process of coining is at the Philadelphia Mint which, in 150 years of operation, has turned out 13½ billion of the more than 19 billion coins produced in the U. S.

The first step is the engraving of the master dies from which are made the working dies used in the coining machines. Full-sized copper electrotypes of the obverse and reverse (head and tail) sides of the coin are made from plaster casts which are replicas

3 A master die, made from electrotype by a tridimensional pantograph. Of eight pantographs in the U. S., two are in Philadelphia

4 First step in the actual coining process is to make a working die. Here a cone-topped die blank is being turned from a two-inch steel bar Cone is carefully ground and polished, for any roughness is impossible to get rid of in the later stages

5 In a 55-ton press, the master die "strikes" its design on the working die. Under the terrific pressure, the latter will expand 1/32 of an inch

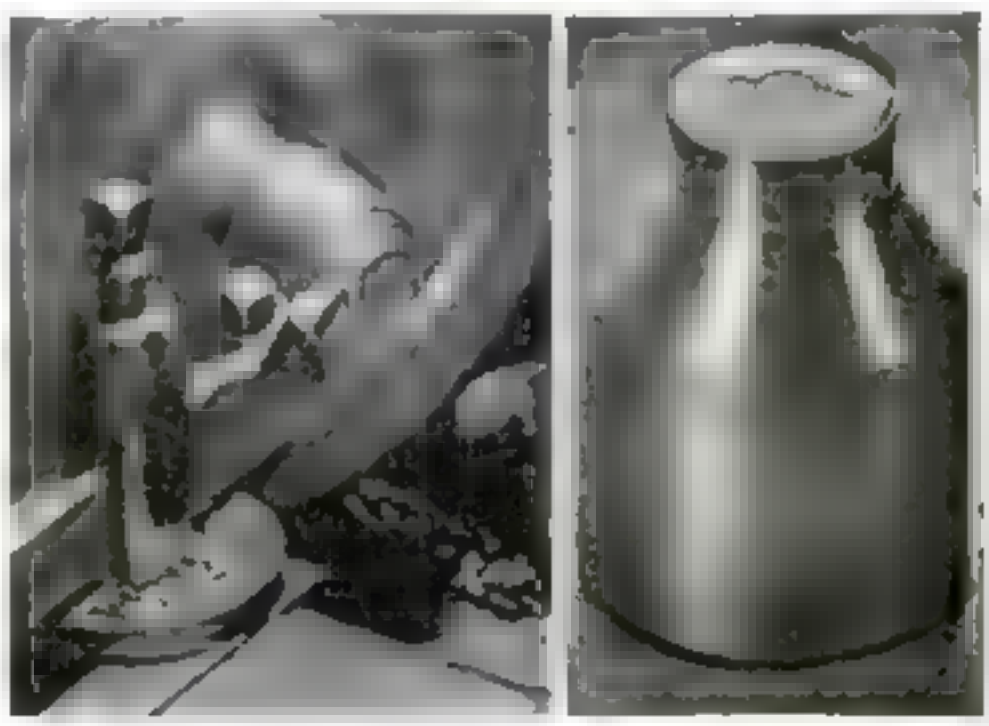
6 Three "strikes," and the die is out. Left to right, the die as it appears after the first strike, the second, the third—each progressively sharpening its detail. "P" seen on opposite page above the dome of Monticello is Philadelphia Mint's mark

Nickel

of the designer's clay-sculptured originals. From these electrotypes the design is reduced to coin size and the master dies, often called master hubs, are created mechanically by a tridimensional pantograph.

Next comes the making of the working dies. A cone-topped die blank is machined out of a two-inch-long piece of 1½-inch-diameter bar steel, and is then carefully ground and polished

Because the master die has its de-

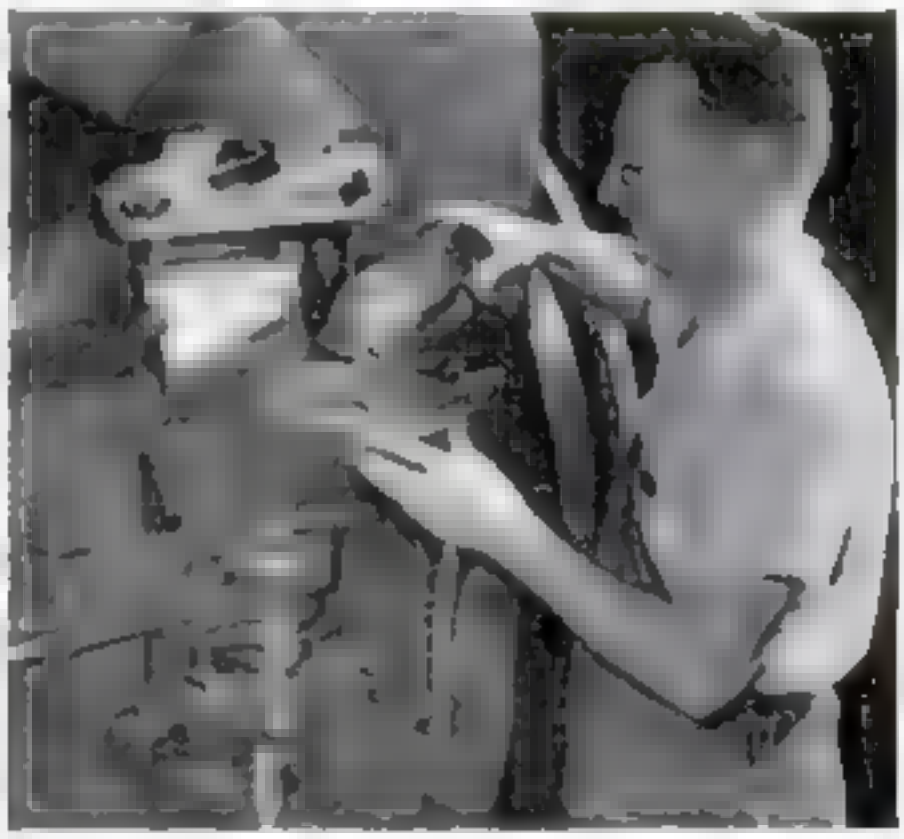


7 After being turned down to coin size, then hardened and polished, the working die, above right, is complete

8 Instead of the 5¾-pound ingots that were formerly used, which were composed of 25 percent nickel and 75 percent copper, the new Jefferson nickels are made from 52-pound ingots compounded of silver, copper, and manganese, in the proportions shown above

9 After the metals have been melted down in a 1,750-degree electric furnace, they are cast into the 52-pound ingots which are annealed in cold water. Here the ingot is passing through one of a series of break-down rollers

12 After another process of annealing, which is necessary if they are to be of a sufficient softness to take the die's impression, the coins are bathed in a revolving drum which contains acid. Here the shiny new blank coins, which have already received their "collars," are now prepared to receive their "faces"



13 In this automatic coining machine, blank coins are seized by the fingerlike pincers of a moving arm and held while obverse and reverse dies are driven upward and downward on them. Under this pressure, the soft metal flows into the depressions of the die

sign in low relief, the design in the working die must be depressed, so that when the die is stamped down on the coin blank the pressure will force its metal up into every minute depression of the design, which will appear in molded low relief on the coin. To depress the design in the working die, the die blank is placed in a 55-ton hydraulic press which strikes the master die three times into its cone-shaped top.

After the third strike the design end of the die is machined down to the collar size of the coin—the size of the coin inside its raised rim. Then the die is hardened and polished.

Mint marks usually are hand engraved on the working dies. On the Jefferson five-cent pieces they appear over the dome of Monticello. An "S" shows that the piece was coined in the San Francisco Mint; a "D" that it was produced in the Denver Mint; a "P" that it comes from the Phila-

10 From the breakdown rollers, the ingots are put into finishing rollers, such as the one above, which reduce the ingot to the exact thickness of a nickel. At this point, a number of micrometer and weighing tests are made to insure precision

11 Strips are fed into this machine which then punches out 900 blank coins a minute, the remaining metal being recast in ingots. Blanks are now ready for the "collar" which appears around the circumference of all finished coins

14 Inspection is made by girls working in pairs, one watching one side of the coins as they pass on a conveyor belt which then automatically turns the coins over for the other girl's inspection. A final automatic machine drops 1 000 nickels into a bag, ties it—and the bag is ready for shipment

delphia Mint. On coins other than the five-cent piece, the mint mark now appears in the lower right of the obverse side.

Just as important as the making of the dies is the preparation of the metals which are coined into money.

The make-up room is a dingy treasure chamber in which husky workmen sweat as they wrestle with 80-pound bars of dull-gray pure silver *(Continued on page 322)*

Blueprint For

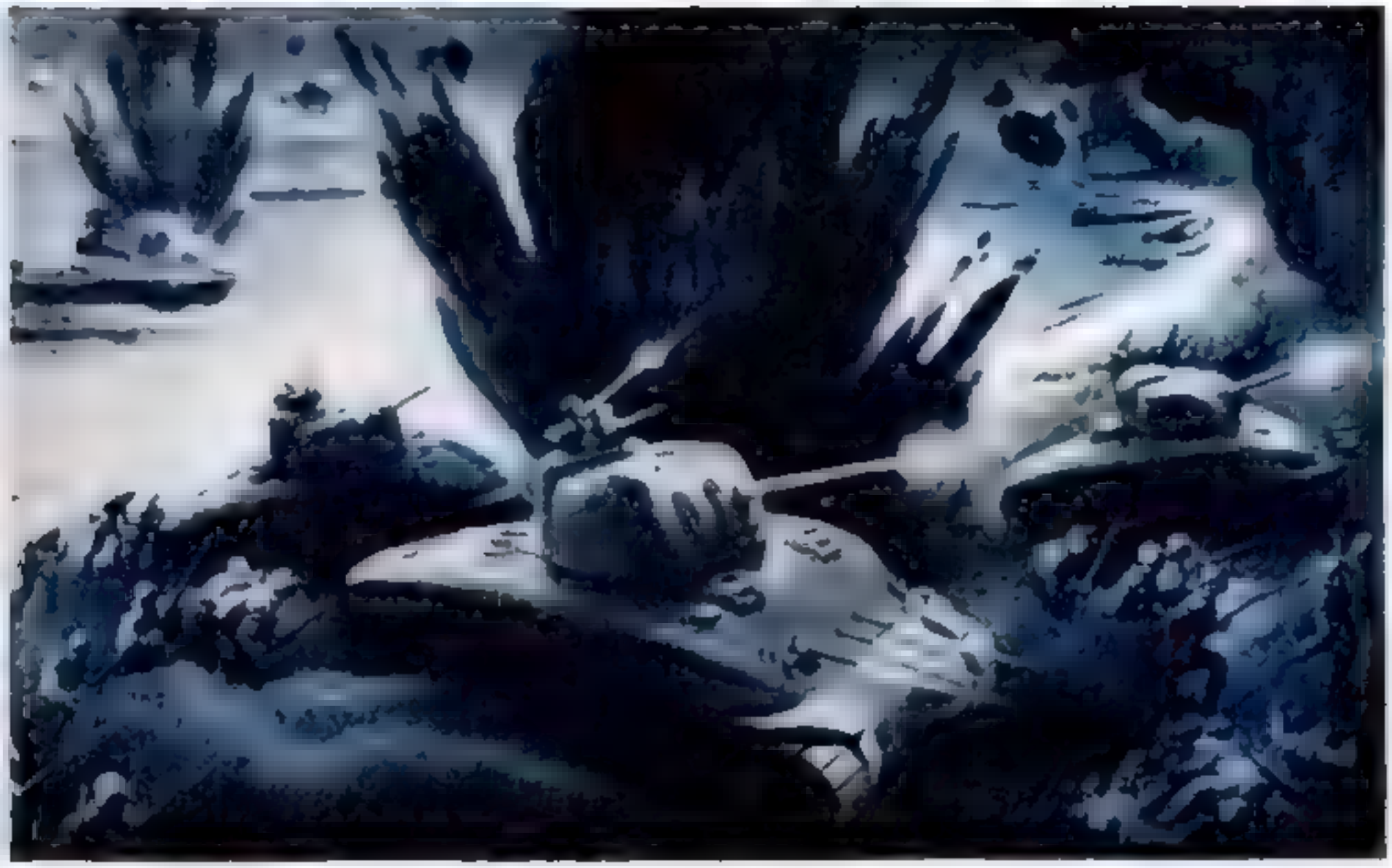
Careful Preparation and Long, Elaborate Training Lie Behind a Landing on a Fortified Enemy Coast

SOMEWHERE off a hostile coast, in the damp cold an hour or two before daybreak, infantrymen clad in heavy waterproof suits take their places in shallow-draft assault boats. They may embark from an island or other land base within striking distance of their objective, or from transports screened by a naval force. Bigger assault craft, resembling vehicular ferryboats, are loaded with tanks and field guns. Everything has been rehearsed: in a short time the assembled armada is churning toward a designated point on the coast. The curtain has risen on the drama of invasion, but the stage is still dark.

If luck is with the attackers, they may catch the enemy napping and the first units may land without opposition. But at some point in the operation hell breaks loose. The sky explodes in orange flares amid the rattle of machine guns and the bursting of bombs and shells. The assault boats hit the beach, their bows drop like drawbridges and the men and tanks swarm ashore. The leading units snip the barbed-wire entanglements with cutting tools and clear the way for the main attack. Assault engineers blast barricades and open roads for heavy equipment. Mortars and fieldpieces set up on the beach cover the advance.

This is aero-amphibious war, and the action is not confined to sea and land. Airplanes fight overhead. Parachute troops drop from transport planes and infantry-filled gliders are towed into the zone of action. As the operation develops every type of soldier takes part. Smoke screens are laid by chemical-warfare units to conceal the successive waves of assault boats which, hour after hour, ferry infantry, armored forces, signal and medical units, and detachments of all the arms and services to the disputed beach. The issue is decided in a few hours: either the attackers are driven back into the sea with disastrous losses, or they have thrust the spearhead of invasion into the enemy's coastal defense line.

Since the fall of France and the evacua-



Invasion

By CARL DREHER

tion at Dunkirk, the military experts of the press and radio have been warning us that landing on a hostile coast is the most costly, difficult, and hazardous of military undertakings. No doubt there is much truth in these cautions—but they did not worry the Germans too much when they wanted Crete, nor the Japs in their leapfrog advance from Formosa to New Guinea. Nor have they ever worried the United States Marine Corps. With their rubber assault boats, amphibious tractors, transport planes, and gliders, the Marines have pioneered in many phases of invasion technique The only trouble with them is that they are a comparatively small outfit, and large-scale invasion calls for quantity as well as quality. Our landings in Africa have shown how well their technique can be applied on a large scale.

The Japs went into the invasion business in a small way in China and graduated into the big time later. They developed a definite technique which is worth studying. In all cases they first reconnoitered landing sites carefully from the air. Besides, they had been there before, fishing and so on: thus they knew the country and had good connections ashore. When they came to capitalize on their preparations it was usually with a task force comprising a battleship or heavy cruiser, an airplane carrier if required, destroyers, and enough transports to carry about two divisions (40,000 men) with normal equipment, including 75-millimeter field guns and 105-millimeter howitzers, and light tanks. Almost always they arrived just before dawn, on a day when high tide came soon after dawn. The battleship stood out between three and four miles, the destroyers lined up about half a mile out, the transports were in between. The troops climbed down the sides of the transports into landing boats, or, in some cases—this was an original idea which they apparently developed from the design of whaling ships—side hatches opened and the boats, already loaded, slipped into the water.

The landing barges comprised several types, the largest holding about 120 men, while smaller ones carried 50 or 60 men apiece. Speeds were about 10 knots. The boats were generally armored in the bow and stern. Those carrying tanks or artillery were equipped with a bow which could be lowered, somewhat like a bascule bridge, forming a ramp down which the equipment could be wheeled off. [*CONTINUED*]


HIGH-ALTITUDE FIGHTER PLANES
BOMBERS
FEINT
FEINT
LANDING BOATS
COAST DEFENSES BOMBED
LOW-ALTITUDE BOMBERS
MAIN OBJECTIVE
LOW-ALTITUDE BOMBERS

SEA, LAND, AND AIR FORCES JOIN IN INVASION PATTERN

This is our artist's conception of the way in which the various elements of amphibious war are combined in making a landing on an enemy-held fortified coast line. It is based on techniques first used by the Japanese and Germans and amplified by the United Nations. While the heavy vessels of the naval escort bombard coast defenses, landing boats and barges ferry men and mechanized equipment between transports and the beach. From the air, bombers escorted by fighter planes demolish enemy installations. Parachute troopers drop behind the enemy's lines to disrupt his communications and supply, while glider troops and men in the zone of combat to reinforce those swarming up the beaches. Some of the landing attempts are only feints, some fail, but those that succeed are rapidly exploited to thrust spearheads through the enemy lines.

Drawing by B. G. SEIESTAD

TROOP-CARRYING

NAVAL VESSELS SHELL ENEMY INSTALLATIONS

FEINT

FEINT

Infantrymen

Everlasting drill trains men in the specialized work of landing operations. Here they are swarming down a cargo net into a dummy landing boat; the black bag holds a machine gun. Practice makes every move a matter of habit. If a man falls in the water, he can drop his equipment quickly, as shown by sergeant at left

The boats also had other advantageous features, such as double keels for stability when they were beached. They were, of course, shallow-draft craft which could get high up on the sand before grounding. One type was a hydroplane, airplane-propeller-driven, for use in creeks, weed-bound water, and the like.

The Japs used their men and equipment skillfully, taking full advantage of surprise and secrecy. They always saw to it that they had air superiority. By the time they were discovered they usually had a sizable force on shore and under cover. Then their aircraft were swarming overhead and the guns of the fleet protected the balance of the landing.

The Germans at Crete relied more on air power than on such a balanced combination. Actually they likewise started with a seaborne force, but their intelligence service proved deficient in this instance: the strength of the British was several times greater than had been estimated. The Germans then shot the works in the air; they were able to do this because enough land-based aviation was available and preparations had been made for just such a contingency. They came in gliders carrying 12 to 30 soldiers apiece, towed by lumbering old transports which were perfectly suited for this new job. As many as 10 or 11 gliders were strung out behind each towing plane. They also used parachute troops, and, when they had captured an airport, ferried their infantry across the water in transport planes. By these methods, in a few days they landed 15,000 troops on the island, equipped with rifles, light and heavy machine guns, field-pieces, medical supplies, and about everything else they needed.

This operation has been carefully analyzed by our Army. Lieut. Gen. Henry H. Arnold, the chief of our Air Forces, refers to it as the "awful lesson of Crete"—the lesson being that neglect of air power as a paramount factor in invasion is a fatal error, and that we must not only take into account air power as it exists today, but beat the enemy to the punch in new developments.

The general pattern which emerges is fairly clear. To get a foothold on a hostile coast, and to hold and enlarge that foothold with reasonable assurance of victory, one must have air superiority, naval superiority, and ground superiority. The three factors are not concurrent; more precisely, the requirements are initial air and naval superiority, with a view to converting potential land superiority into actual land superiority in the course of the operation. One may win with only initial air superiority, as the Germans did at Crete, but to do a workman-like job, with the utmost economy of men and matériel, one should possess preponderance in all three elements. And of course these elements are not to be regarded as disparate. When the opposed forces are

anywhere near equal, the deciding factor is the co-ordination between air, sea, and land forces. These must be under unified command. Landing operations are a peculiarly clear illustration of the principle that the strategic whole is all that counts—the parts matter only in so far as they contribute to the whole.

In our own Army progress in this direction is reflected in many ways. One which stands out is the organizational setup of the various arms. As long ago as November 1941, Lieut. Gen. Hugh A. Drum argued that the "present watertight compartments" existing between air support, armored forces, and other arms must be broken down. They *are* being broken down. The basic classifications still exist, but there are numerous new combinations which at first sight are rather puzzling. We find, for instance, the Engineer Amphibian Command—of the Army—recruiting sailors, commercial fishermen, and marine specialists of various kinds, the purpose being to get fighting men ashore where they can attack the enemy, and to maintain the craft which will do the job. This command alone is recruiting men from 40 different fields—automobile service men, crane operators, lifeguards, plumbers, sheet-metal workers, and surveyors being a few of them. Then we have a Special Service Force equipped to engage in parachute, marine landing, mountain, and desert operations. Also to be mentioned is the Airborne Command which links the Air Forces and the Ground Forces, but belongs organizationally to the latter, while the Troop Carrier Command, likewise a bridge between Air Forces and Ground Forces, belongs organizationally to the former.

After a little study one gets the logic of it. These hybrid military units, and their interconnections with the Navy, reflect the in-

There's a knack even to getting out of a landing boat. The sergeant demonstrates perfect form in a technique designed to get men ashore quickly ready for fighting

Like a boy going over a fence, he turns his body and lands on his feet facing forward, his rifle held aloft

Hitting the beach. Men are taught to scatter and seek cover as fast as they can, to minimize loss. After weeks of such practice, these soldiers will move like clockwork when they make a real landing

Practicing for a reconnaissance landing, sea infantrymen unfold and inflate a rubber assault boat ...and carry it down to the water's edge. Such boats can be kept under cover when they are not being used

creasing complexity of modern warfare, the need for teamwork and continuous co-ordination among the arms and services. The more specialized the soldier's task becomes, the more necessary it is to integrate the efforts of the specialists so that they will serve that strategy of the whole which, on pain of disaster, must never be neglected. And the orientation of the whole complex setup is toward the invasion effort and what will follow.

The same drive is reflected in war industry and in Army and Navy equipment. A single firm advertises among its products motor torpedo boats, steel Diesel-powered tank carriers, crew-carrying landing boats, motor-equipment landing boats, armored combat boats, shore patrol craft, anti-submarine motorboats, steel and wood tugboats and barges, and "amphibious equipment." In the air, the Army is training men in transport gliders which will carry nine fully equipped soldiers. Another type carries 13 infantrymen in addition to the pilot and co-pilot. These gliders drop their wheels after taking off and alight on skids. Experimentation is in progress with a view to picking up gliders from the air after they have landed in enemy territory. Cargo planes can now fly antiaircraft guns, 75's and 105's, reconnaissance cars, and about everything except heavy artillery to the combat zone. They carry troops as well—the Curtiss-Wright C-46, the "Commando," holds a substantial number of fully equipped soldiers. Among combat craft, there are types like the North American P-51, the "Mustang," which are especially designed for hedge-hopping and close support of troops. One of these days we shall see them swooping over the beaches clearing the way for landing parties and scouting the terrain further back.

No one in the armed forces is under any illusions as to what we shall be up against when the big push starts. Undoubtedly the landings necessary to open a second front in Europe will be exceptionally difficult. The Germans have had plenty of time to fortify the likely spots along the Channel coast and elsewhere. It is quite possible that published photographs of German gun emplacements, batteries, blockhouses, and redoubts have been deliberately allowed to filter through in order to give the leaders of the United Nations pause; certainly these steel and concrete strongholds are a formidable obstacle. Some of them appear to be so massive that it is doubtful whether random bomb hits from the air would penetrate them. Others have been dug into the sides of hills so that they are clearly invulnerable from above. Certainly there is a big difference between making a landing in the face of one of these monstrous constructions, and, for example, the uncontested or weakly contested Japanese landings in the Pacific.

But does that make the coast secure against invasion? To answer the question let us transfer the scene to the United States and see how it looks from the defenders' viewpoint. The distance from the resort island of Santa Catalina to the nearest point on the Southern California coast is exactly the same as the width of the Straits of Dover—20 miles. The California coast line is well fortified, and back of the fortifications there is a superb network of roads, all kinds of airports and aircraft factories, and probably more heavy industry than in some of the corresponding areas in France. Yet how secure would the people of Los Angeles and their defenders feel if Catalina were as big as England and the Japs were looking across the channel at the Palos Verdes Hills? How secure would they feel if the Japs had air superiority and there was little or no prospect of taking it away from them in the calculable future?

The fact is that coastal fortifications have a definite but limited utility. Their big guns can be used against shipping, including naval vessels and transports. As long as these batteries are active the United Nations

Motive power is supplied by paddles, men straddling the doughnut gunwales with rifles ready at their backs

Arrived at the hostile shore, they drag the boat out of the water to balk enemy scouts and air observers

cannot cover a landing with naval guns, they cannot dock transports in existing harbors. But against small and medium-sized landing boats, barges, and lighters, heavy artillery is practically useless. The boats will come in close under cover of darkness and they will land under smoke screens. The big guns cannot be trained on the water close to the shore or on the shore itself. The defenders will have to rely on light artillery and small-arms fire to repel the actual landings; thus the situation will be much like that at points on Luzon where we had such defenses—and the Japs took them

Nor is a seacoast a neat geometrical pattern, every foot of which can be covered by fixed or mobile artillery. Seacoasts were not designed for the security of the Nazis or of anyone else. They are complex, irregular configurations where resolute attackers who know the terrain can find innumerable coves, bays, inlets which at a given moment may be undefended or inadequately defended. The attackers will naturally avoid the obvious spots; they will know that a difficult landing site—difficult in the sense of terrain may be their best bet because of the element of surprise and the unpreparedness of the enemy.

Gaining footholds on the beaches is the first stage of the invasion. Some of these footholds will be lost, some will be held. The second stage calls for reduction of heavy fortifications at critical points, so that the third stage—the acquisition of a deep-water harbor—may become possible. The fortifications can be reduced. Anything which can be built can be blown up. If it can't be blown up at long range it can be blown up from alongside. The Germans themselves proved that when they took the multiple fortress of Eben Emael, near Liege, in the spring of 1940. These installations were said to be proof against artillery fire, and in fact they held out to the end against all the cannon the Germans were able to train on them. But they could not hold out against engineer

Under cover of the nearest growth, the craft is camouflaged with leaves and branches. Now the detachment is ready to melt into the jungle and accomplish its mission

A scout car goes over the side of a U. S. transport into a landing barge during maneuvers. Craft like this can carry jeeps, tanks, and field-artillery pieces ashore under fire to support infantry landing on the beaches from smaller boats

These British barges took part in the "rehearsal" at Dieppe, ferrying Bren-gun carriers and tanks across the Channel. Note how the bows drop to allow vehicles to be run off onto the beach as soon as the craft have run aground in shallow water

combat units armed with explosives, advancing under cover of continuous artillery fire and utilizing shell craters for cover until they reached the blind spots close to the walls of the fortifications.

We have plenty of dynamite and TNT, and American engineers are just as tough as German engineers—maybe tougher. The fortifications will be assailed from the flanks by lateral landing parties, from the rear by airborne troops, and at a given stage they will face frontal assaults by new landing parties. These redoubts are set back some distance from the shore, usually on elevations commanding the sea. The approaches will be churned up by bombers until the terrain will look like a series of gravel pits. There will be plenty of cover for the later landing parties. At the same time, naval units may engage the fortresses in artillery duels; the close-up attacks already in progress will compensate for the advantage shore batteries normally enjoy over equivalent calibers on the water. The fortifications will be subjected to simultaneous assaults from the air, the sea, and the land. Where they are immune to normal vertical and dive bombing, low-flying aircraft may loose projectiles, which will bring them in at angles close to the horizontal, like torpedoes launched at warships.

The defenders will always be able to repel a single landing attempt. But they will have to contend with multiple raids—perhaps a dozen or more at a time. Even in the Dieppe operation, which in retrospect will seem like little more than a threatening gesture, the British were on six beaches at once. Of course, *(Continued on page 124)*

Landing boats like these play a large part in the tactics of amphibious war. Maneuverability and high speed make them hard to hit, while shallow draft and shelving bows enable them to run far up on beaches

A heavily armored barge slides down the ways into fresh water at an inland shipyard. Built for the Navy and designed for ocean-going service in landing operations, it can hold a large amount of equipment

Tank carriers that got their baptism of fire at Dieppe. They are seen moored alongside a British destroyer after the raid. One has a Bren-gun carrier still aboard. In large-scale landing operations, armadas of vessels like these approach the enemy-held coast under cover of darkness to avoid artillery fire, attack at dawn

Throw-Away Planes Are Convoy Escort

Slashing through forest and prairie for 1,600 miles, the Canadian-Alaskan Military Highway provides a well-graded well-drained truck road for transporting men and supplies

Six-Month's Miracle

How U. S. Army Engineers Conquered Bogs and Forests in One of the Greatest Road-Building Jobs of Our Day

ALL this winter, thousands of trucks will roll to the far north with soldiers and supplies. The first of them already have passed over a newly built highway between the United States and Alaska—a long-dreamed-of project ranking among the greatest engineering feats of modern times.

Starting from Edmonton, Alberta, and Dawson Creek, British Columbia, where road and rail in turn had given up their struggle northward against the Canadian wilderness, the new highway drives through 1,600 miles of prairie, forest, and a 4,000-foot mountain pass to reach Fairbanks, Alaska. At this hub of the Territory's transportation system, it connects with the Alaskan Railroad to the port of Seward, and with airways to far outposts and defenses of our northern empire.

Imperative war need has created the Canadian-Alaskan Military Highway—called the Alcan Highway for short—in the almost incredible building time of scarcely more than six months. Until its construction, the

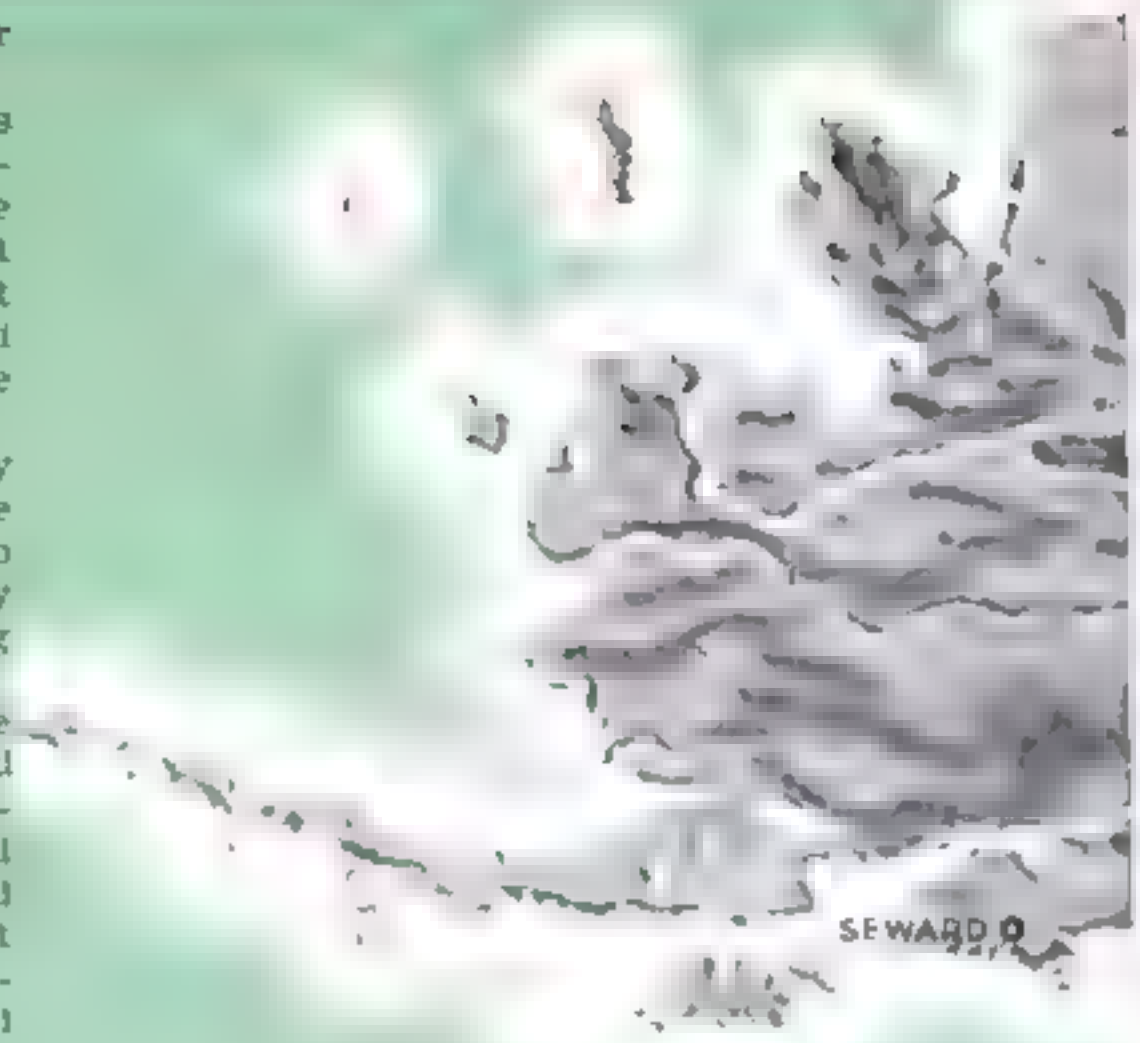
only way to get to Alaska was by boat or plane.

Today, the submarine menace makes the sea voyage hazardous. And if a hostile fleet dominated and blockaded the sea—a remote possibility, but one that prudence demands to be provided against in advance—an Alaska without overland connections for supplies would be at the mercy of the enemy.

Supplying Alaska by air may some day be possible. At present it is not. We simply don't have enough planes, of cargo type, to care for our growing military establishment in the area, to say nothing of the civilian population.

A railroad to Alaska? That would be preferable to a highway, since it could carry more freight. And the War Department has already made an aerial reconnaissance for a proposed railroad leading from existing connections at Prince George, B. C., 1,300 miles northward to the Alaska Railroad. The favored route lies in the natural trench between the Coast Range and the Rocky Mountains, which shelter it from the rigors of the winter season. Once this railroad was built, it would complete the four-way means of access to Alaska recommended by Lieut. General Brehon B. Somervell, Commanding General, Services of Supply —by sea, air, road, the railway. But it takes far more time to lay tracks than build a road, and the Army has therefore concentrated its effort on putting through the Alcan Highway.

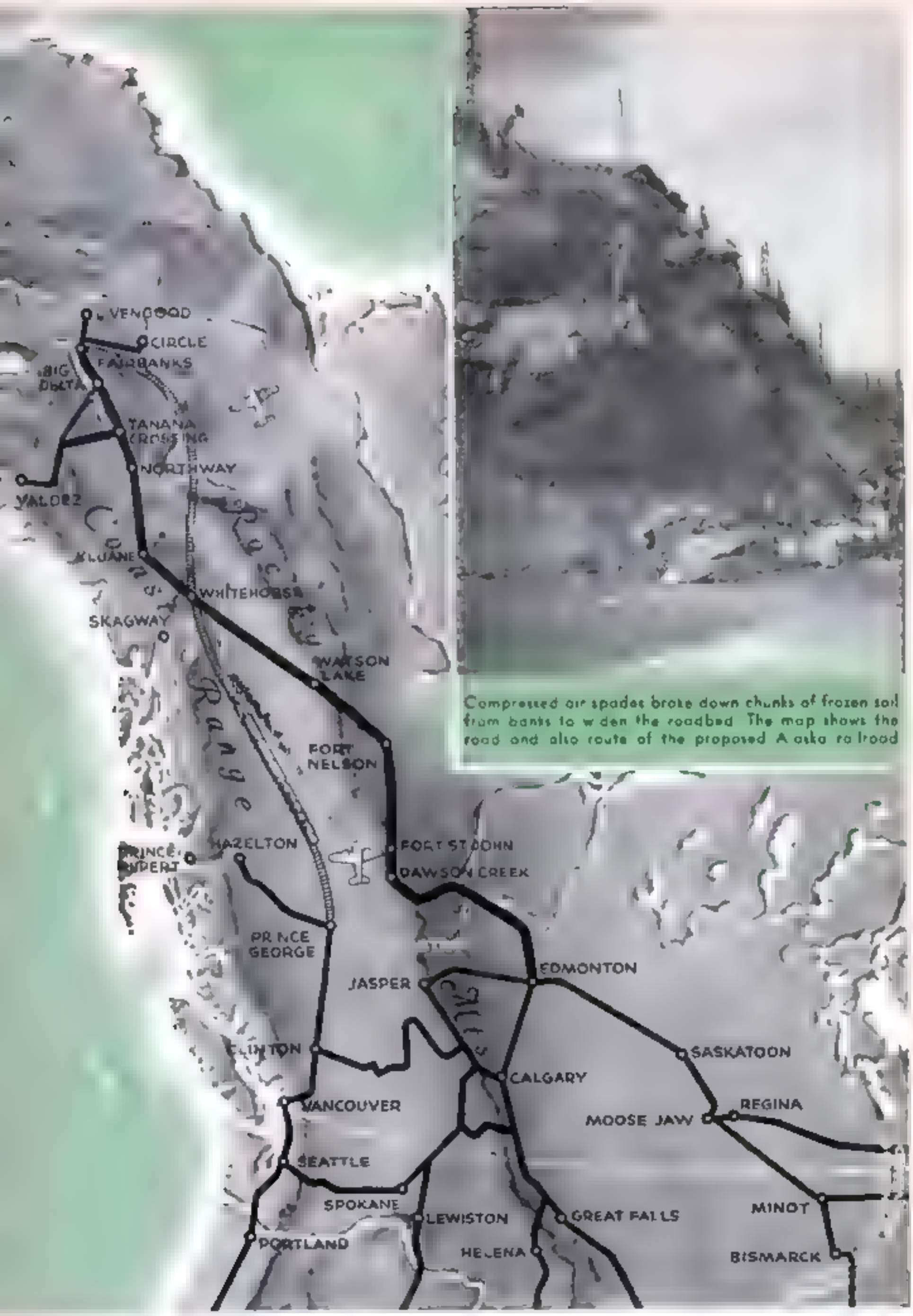
The overland road, as it approaches the United States, swings far to the east of the proposed railroad, and avoids both of the principal mountain chains. This route



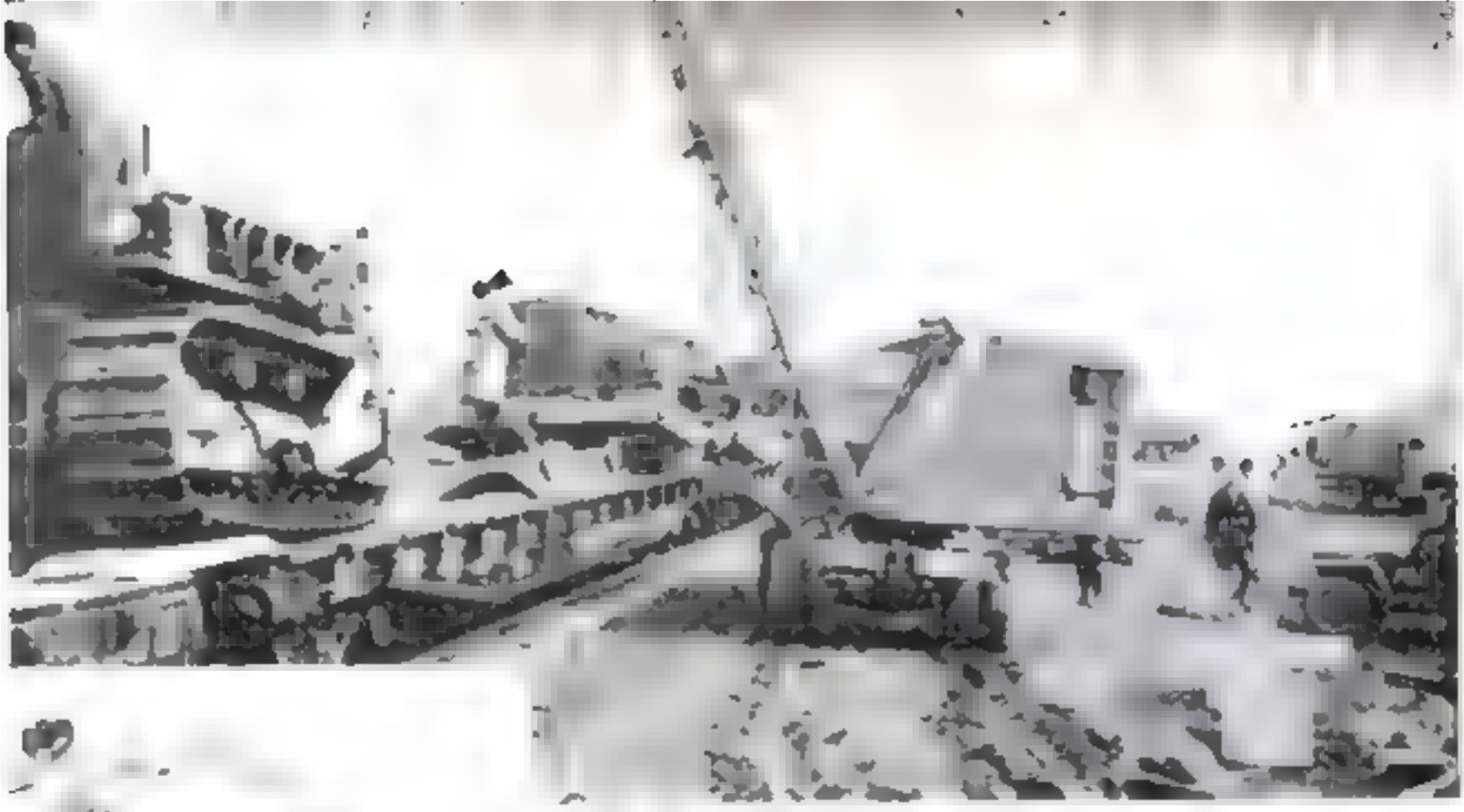
has a number of important advantages. First, it lies farthest from the Pacific coast and therefore from possible enemy bombers, of various routes that have been considered Moreover, even if raiders did reach it, they could do no such damage as to a road hanging on narrow mountain shelves, which well-aimed bombs might put out of commission for weeks. A good-sized bomb crater on the Alcan Highway, which runs through comparatively flat country, could be by-passed by an emergency detour built in 24 hours.

Perhaps most important, the Alaskan road and its southern highway connections afford a direct route to the Twin Cities, Chi-

Ponton bridges like this made temporary crossings for gravel trucks and construction machinery. The permanent bridges are of wood cut and sawed on the spot, easily replaced when broken by ice in spring



Compressed air spades broke down chunks of frozen soil from banks to w den the roadbed The map shows the road and also route of the proposed A aska ra lroad



Giant Diesel tractors being unloaded at Dawson Creek, B.C., end of steel of the Northern Alberta Railroad. To beat the spring break-up, equipment was driven over the frozen waters of the mile-wide Peace River to start its work

This soldier wears a mask for protection against penetrating dust. In summer, the workers toiled in temperatures as high as 90 degrees, fighting mosquitoes and flies

"Towns" along the highway are tiny settlements like the Hudson's Bay Company trading post below, where wilderness trappers and Indians trade their furs for supplies

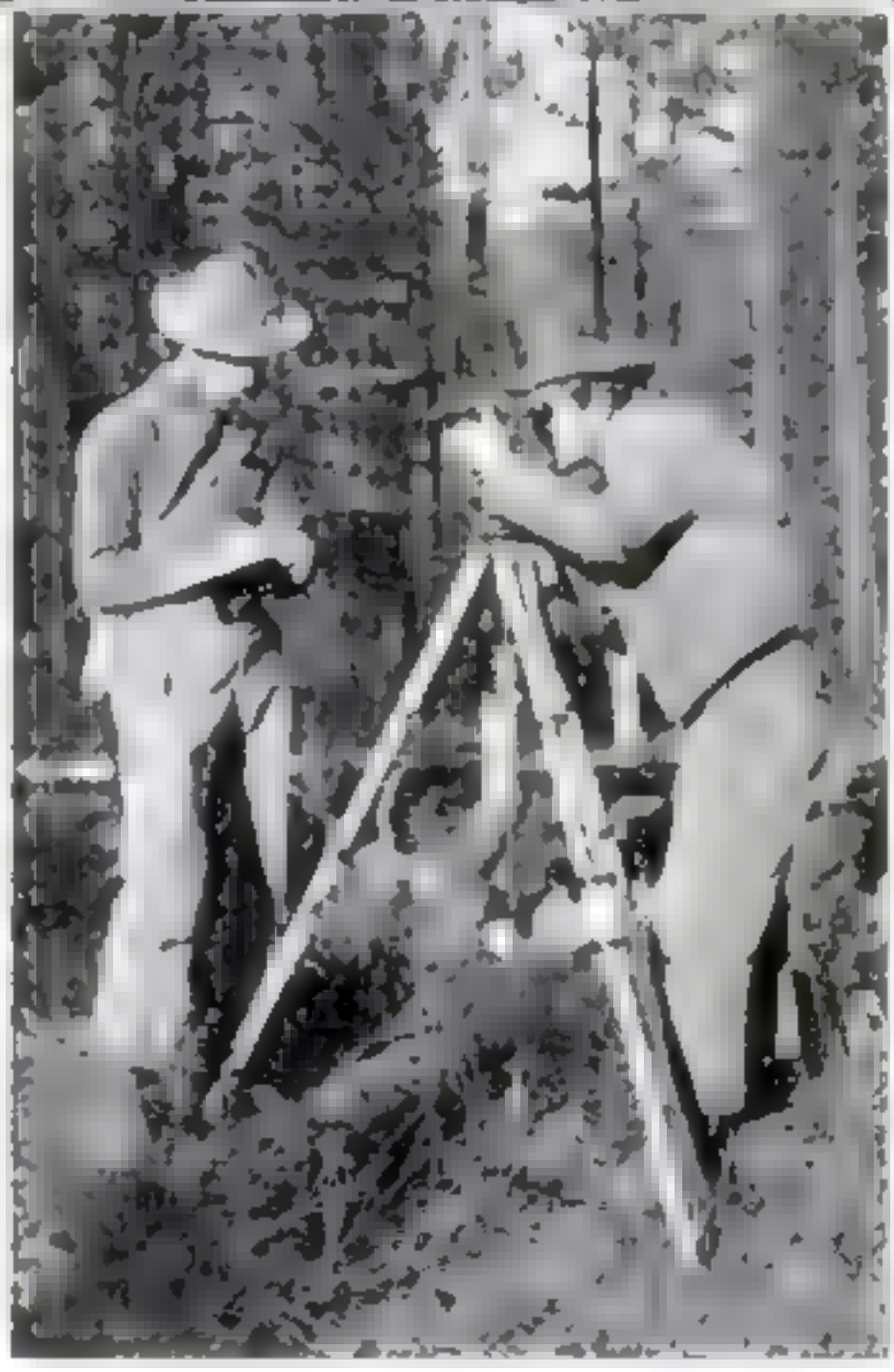
cago, Detroit, and eastward—the great industrial centers where tanks, trucks, and guns are built. There is a saving of from 1,000 to 1,200 miles in distance from any point east or south of Minneapolis and St. Paul. Finally, and most important, the chosen route made for speed in construction.

Providing two-way traffic over long stretches, the Alcan Highway offers a well-graded, well-drained truck road for practically its entire length. Trucks span the distance from Canadian railheads to Alaska in 72 to 80 hours. Traffic is expected to be interrupted in April and May, when river ice carries away some of the timber bridges that cross 200 streams. New bridges, ready cut, and men and machinery to set them up, will be ready, waiting at the trouble spots.

Constructing and operating a U. S. military highway across Canadian territory sets something of a diplomatic precedent. Under the terms agreed to, Canada granted the right-of-way, and the United States did the building and paid the cost. We obtained a road that we had to have, double-quick, more valuable than a battleship and far less expensive. Canada benefits, in turn, from strengthened Alaskan defenses.

At the "go" signal, the U. S. Army Engineers moved in, together with thousands of enlisted men and civilian workers. Construction crews started work at intervals along the route to speed operations. First through the forests crashed the bulldozers, powerful little machines that plowed down spruce, jackpine, and aspen like cornstalks,

Muskeg, the tussocky bogland of the subarctic, was expected to be a great obstacle. Army engineers conquered it with corduroy roadway—logs laid side by side and covered with gravel and glacial silt



Scouting ahead of the construction gangs, soldier-surveyors prospected with transit and level to find the best line for the road through the wilderness

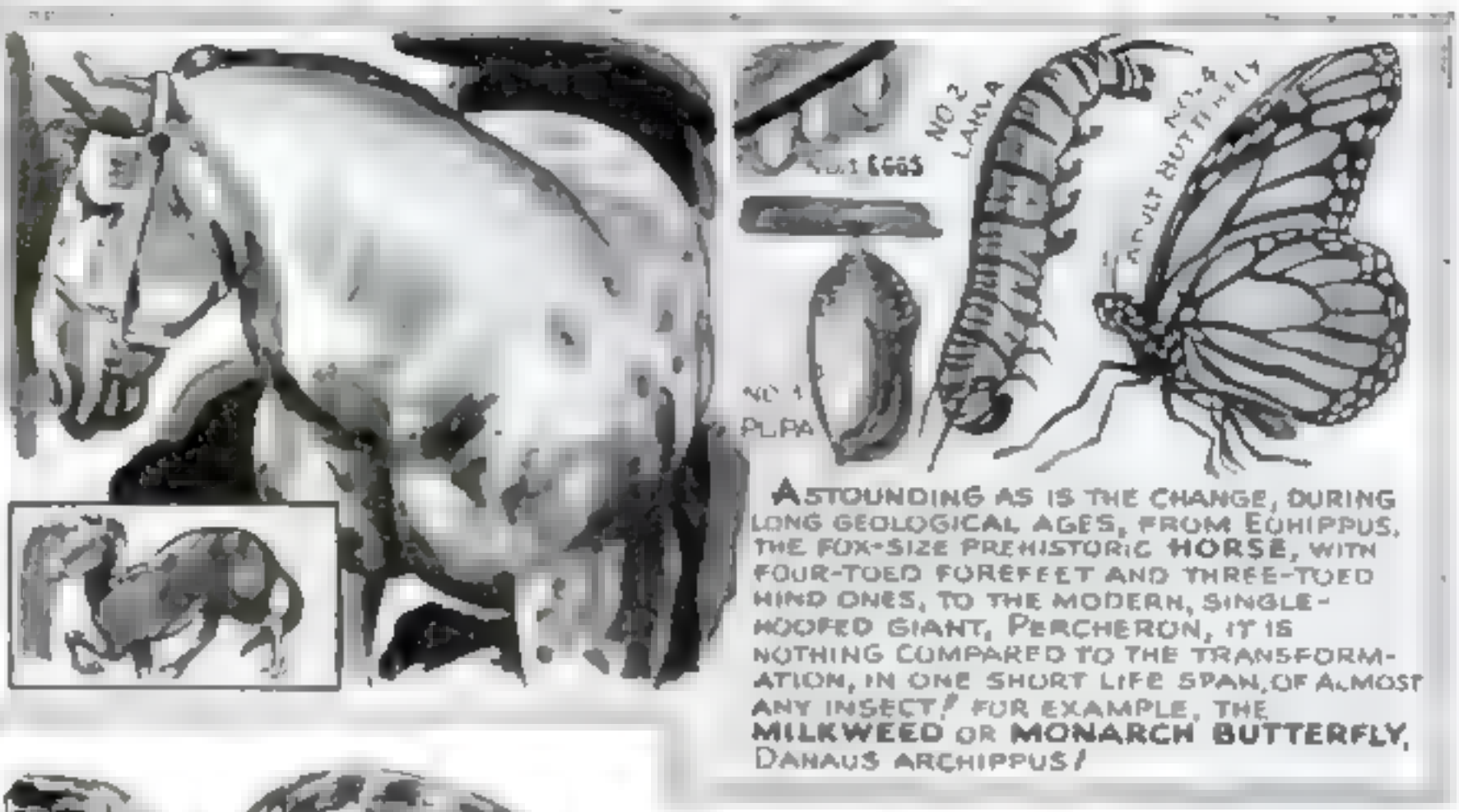
and tossed them off a 100-foot cut. Forces of men cleared the trail they had left.

Unconcerned by scarcity of steel, the Engineers felled timbers for building bridges, which were fashioned by sawmills at the site. Rafts on pontons served as ferries for crossing turbulent creeks and streams. The troops toiled last summer under temperatures as high as 90 degrees, and had to wear gloves and net helmets for protection from swarms of mosquitoes and flies. In wet weather, they slogged through bottomless mud; when it was dry, they stirred up clouds of all-penetrating dust.

Traffic on the Alcan Highway will be of two sorts. Soldiers and their equipment, light and medium artillery, war tanks, and ammunition of all kinds will go northward as needed, as well as food, clothing, oil, and stocks of gasoline for ground vehicles and for planes. Southbound trucks will not return empty, for they will carry raw materials important *(Continued on page 232)*

Un-Natural History

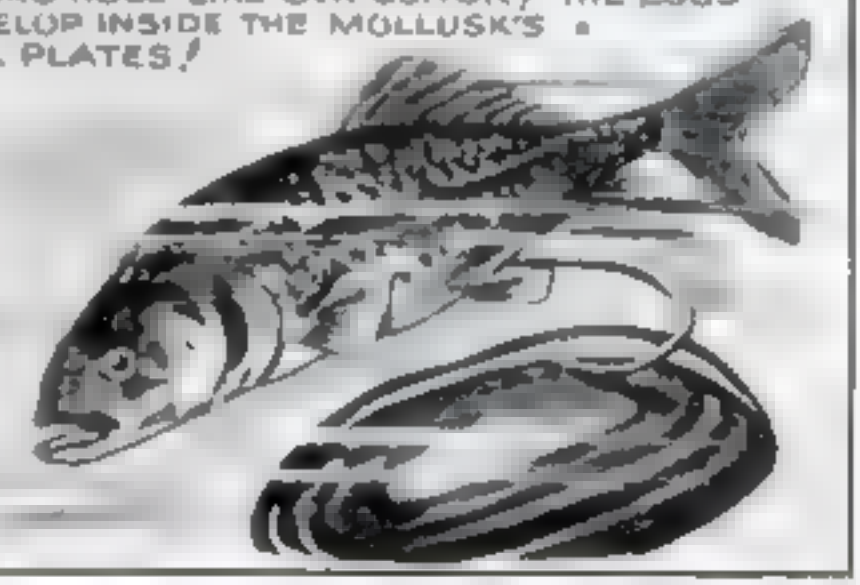
BY Gus Mager



ASTOUNDING AS IS THE CHANGE, DURING LONG GEOLOGICAL AGES, FROM EOHIPPUS, THE FOX-SIZE PREHISTORIC **HORSE**, WITH FOUR-TOED FOREFEET AND THREE-TOED HIND ONES, TO THE MODERN, SINGLE-HOOFED GIANT, PERCHERON, IT IS NOTHING COMPARED TO THE TRANSFORMATION, IN ONE SHORT LIFE SPAN, OF ALMOST ANY INSECT! FOR EXAMPLE, THE **MILKWEED** OR **MONARCH BUTTERFLY**, DANAUS ARCHIPPUS!

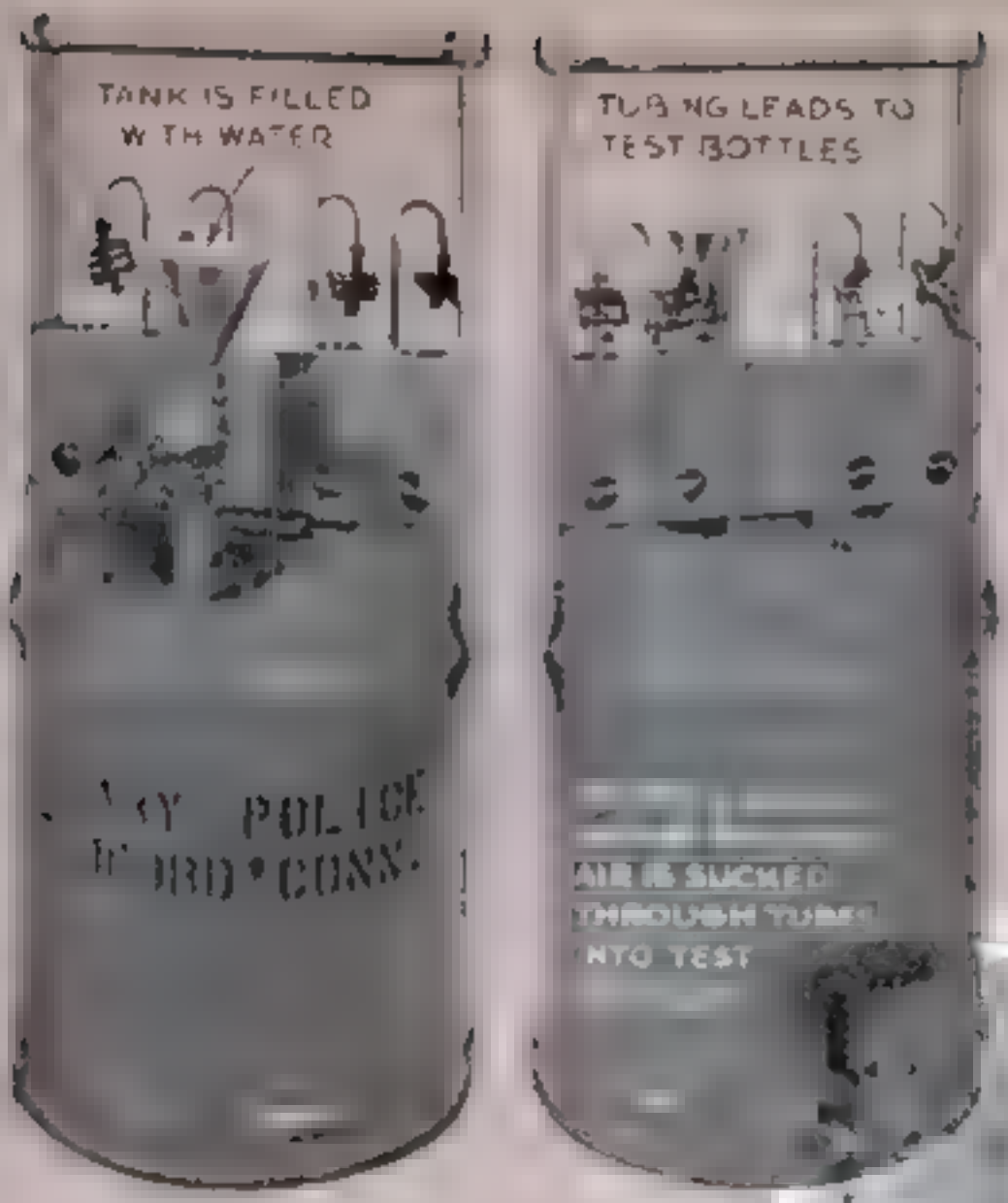
HERE IS THE **THREE-TOED BOX TURTLE**, EXCEPTION TO THE RULE! ALL OUR OTHER BOX TURTLES HAVE FOUR CLAWS ON EACH HIND FOOT! EVEN THEN, A FREAK WILL TURN UP IN THIS VARIANT, LIKE A FOUR-LEAF CLOVER, WITH THE REGULATION FOUR CLAWS!

THIS CONTINENTAL EUROPEAN FISH, THE **BITTERLING** (RHODIMA AMARUS), LAYS ITS EGGS INSIDE THE FRESH-WATER MUSSEL THROUGH A LONG HOSE-LIKE OVIPOSITOR! THE EGGS DEVELOP INSIDE THE MOLLUSK'S GILL PLATES!



CREEPING DEVIL CACTUS, THE WEIRD PLANT FOUND IN LOWER CALIFORNIA, ACTUALLY CREEPS ACROSS THE DESERT, YEAR BY YEAR, LIKE A HUGE, SPINY SERPENT! EACH PLANT LIFTS ITS HEAD, THEN MOVES FORWARD BY DYING BEHIND AND GROWING IN FRONT!

Chemical "Nose" Sniffs Poison Gas

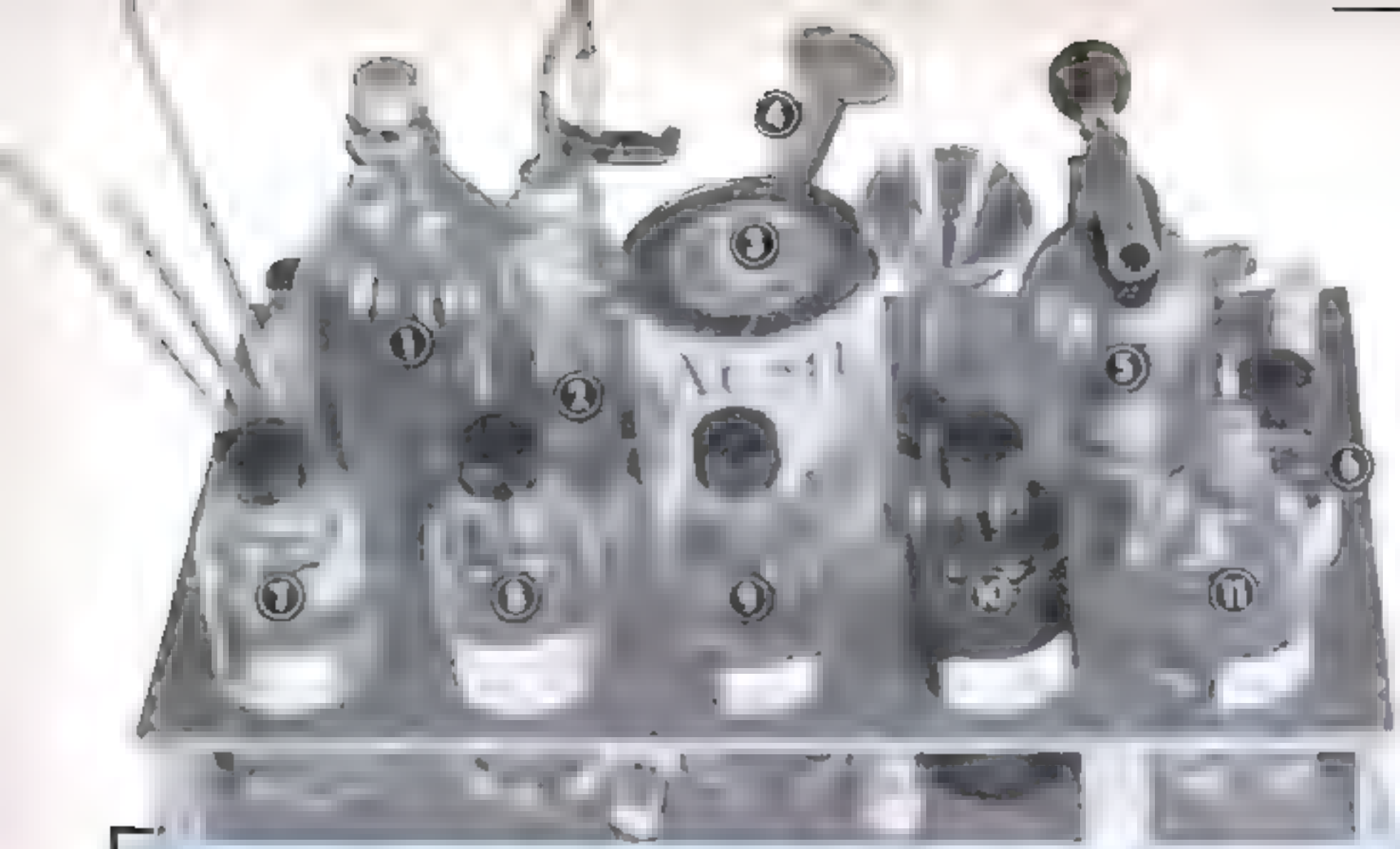


Water flowing from the lower valve of this aspirator creates suction to draw contaminated air through reagents to identify any poisonous war gas present

By HARRY WALTON

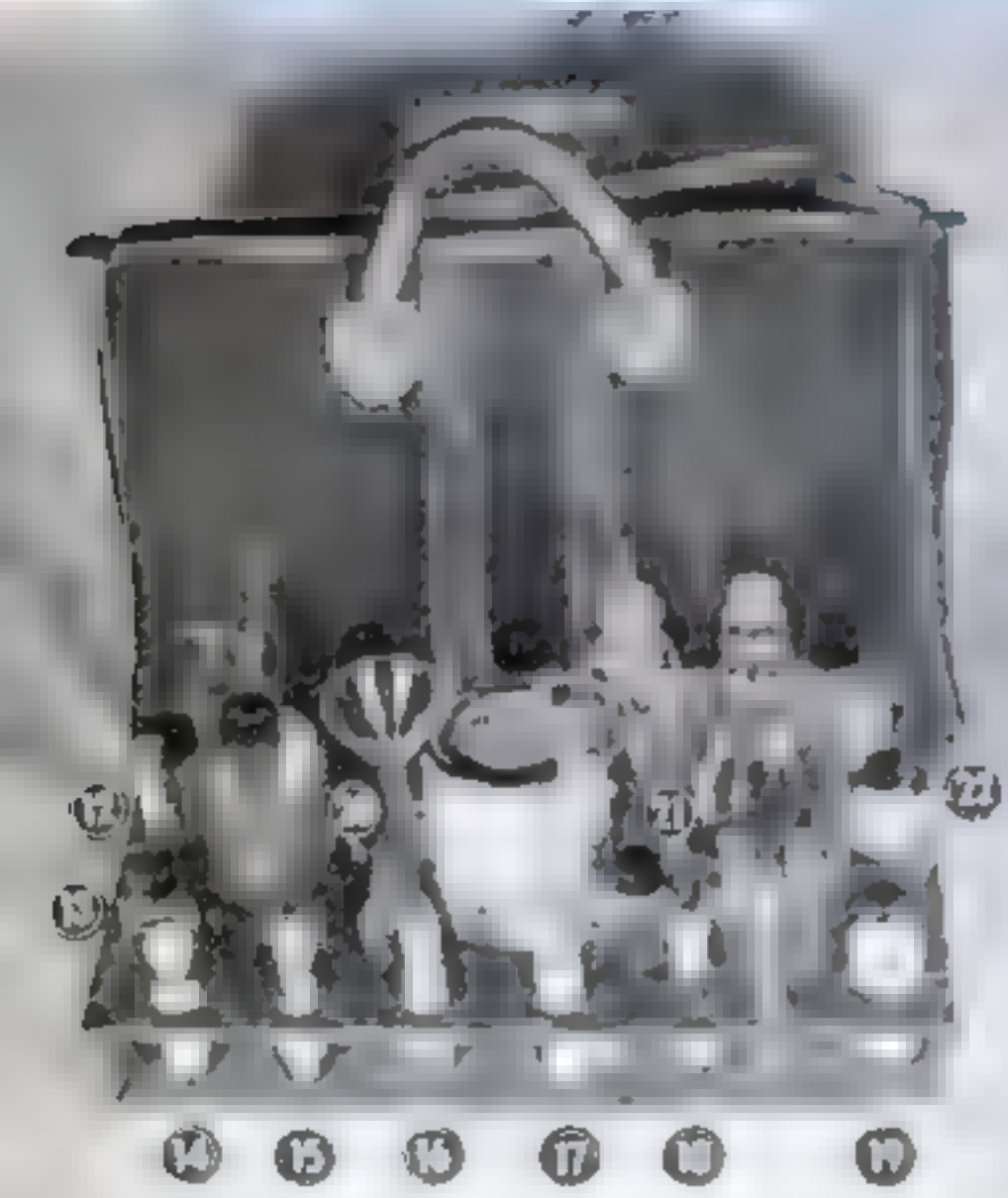
GAS sentries of the Stamford, Conn., Auxiliary Police need not depend upon their trained noses alone to detect poison gases. These sentries are members of the American Chemical Society who, according to their battalion gas officer, Lieut. Theodore F. Bradley, writing in *Chemical and Engineering News* have devised civilian-defense equipment to supplement the sense of smell, which may be deceived by lack of odor and other conditions.

The simplest detectors are test papers that change color when exposed to certain gases. Potassium iodide–starch paper, for example, turns blue in the presence of chlorine, bromine, and nitrous fumes. Potassium bromide–fluorescein paper changes from yellow to red when exposed to chlorine. Both papers are used moist. Filter paper immersed in a solution of ten grams



REAGENT KIT FOR ANALYZING POISON GASES

1 Distilled water, solvent.
2 Hydrogen sulphide generator.
3 Chlorinated lime, reagent.
4 Graduated cylinder, 10 cc
5 Alcohol blowtorch.
6 Cuprous chloride for test paper, reagent.
7 Ethanol, solvent.
8 N-heptane, solvent.
9 Gold chloride solution, reagent
10 Sodium iodoplatinate solution, reagent.
11 Sodium hydroxide solution, reagent.
12 Soluble starch, reagent.
13 Silver nitrate solution, reagent.
14 Potassium iodide-starch paper.
15 Lead acetate paper.
16 Potassium bromide-fluorescein paper
17 Dimethylaniline paper.
18 Sodium iodoplatinate paper
19 Selenium dioxide-calcium chloride, reagent. [Pat. pending].
20 Ammonium hydroxide solution reagent
21 Glacial acetic acid, solvent.
22 Silica gel, absorbent.



Reagents, solvents and accessories used to test poison gas are carried in a rack in a canvas bag. Views of the filled rack are given from opposite sides. The blowtorch helps speed volatilization while testing mustard gas and other contaminants

of dimethylaniline in 90 grams of carbon tetrachloride, and used dry, changes from white to yellow or brown in the presence of chlorpicrin, but the color soon fades

Lead acetate paper, made with a solution of ten grams of lead acetate in 90 cubic centimeters of distilled water, darkens or

COMMON WAR GASES AND THEIR PROPERTIES

Symbol	Name	Persistency	Times as Heavy as Air	Odor	Concentration detectable by odor	Lethal Concentration
					(oz. per 1,000 cu. ft. of air)	
HS	Mustard	Persistent	5.4	mustard, garlic or horse-radish	.0018	.15 (10-min. exposure)
M-1	Lewisite	"	7.1	geranium	.0014	12 (10-min. exposure)
CG	Phosgene	Nonpersistent	3.4	new-mown hay or cut corn	.004	29 (30-min. exposure)
PS	Chlorpicrin	Persistent	5.6	fly paper, anise, licorice		.74 (30-min. exposure)
DM	Adamsite	Nonpersistent	—†	faintly like smoke	difficult to detect	Not obtainable outdoors
DA	Diphenylchlor-arsine	"	—†	shoe polish	.003	Not obtainable outdoors
CN	Chloroceto-phenone	Persistent*	—†	apple blos-soms, ripe fruit	.0001	.34 (30-min. exposure)

*When dispersed by burning (in candles) CN is nonpersistent.

†No vapor density (weight as compared to that of air) is given because the agent does not give off vapor. It is a solid and is disseminated as a solid

becomes black when exposed to hydrogen sulphide.

The more sensitive test papers will react to as little as one part of chlorine or phosgene in a million parts of air, and need only be exposed to the atmosphere. Those for other gases require longer exposure, but their use may be facilitated by placing them in the reagent bottles of a portable aspirator designed by Lieutenant Bradley. This device sucks air in through certain indicator solutions or past test papers. No hand pumping or electrical connection is necessary; the apparatus can be left to operate alone or lowered into cellars.

Although an improved design of the aspirator is being put on the market, and all commercial rights are reserved, Lieutenant Bradley is willing for civilian-defense groups to copy the device for their own use.

A five-gallon solvent pail, fitted with a pipe handle and water inlet and exhaust valves, forms the body. Holes bored in a thick block of wood hold four wide-mouthed one-ounce reagent bottles. Peepholes allow the contents to be seen. Copper tubes with flexible plastic ends connect the bottles to the large tank, which is filled with water. When the water is allowed to flow from the bottom valve, air is drawn in through the several liquid reagents, which change color, form precipitates, or otherwise react to the presence of gases.

One of these reagents will indicate the presence of any of four gases. The solution is made by dissolving one gram of gold chloride and one gram of concentrated hydrochloric acid in one liter of distilled water. Mustard gas turns it milky, carbon monoxide deep-purple, hydrogen sulphide black, and sulphur dioxide pink.

A lye solution (20 grams of sodium hydroxide in 80 grams of distilled water) will decompose lewisite and give off acetylene, which can be detected with freshly prepared cuprous chloride paper in a tube connected with the reagent bottle.

Another reagent is made by dissolving 0.265 gram of sodium iodide in a small quantity of water, adding 0.05 gram of chloroplatinic acid separately dissolved in two cubic centimeters of water, and diluting the mixture to 180 cubic centimeters. This gives a colored solution that can be further diluted with five to ten times its volume of distilled water.

Carbon monoxide, sulphur dioxide, mustard, and certain other reducing gases will rob the solution of its color. If soluble starch is added, mustard gas will turn it deep blue.

Pinch valves on the tubes make it possible to run from one to four tests simultaneously. A funnel having a 100-mesh filter screen assists in testing soil, food, or other substances for contamination. Accessories include a hydrogen sulphide generator for detecting arsine, and silica gel for absorbing lewisite, mustard gas, chloraceto phenone, or brombenzyl cyanide. The khaki paint (patents pending) with which the apparatus is finished contains nigrosine dye, which turns black on contact with liquid mustard gas and with liquid lewisite and blisters on prolonged exposure.

Cluttered with salvage gear, the 110-foot-wide deck of the *Normandie* tilts up at a 79-degree angle

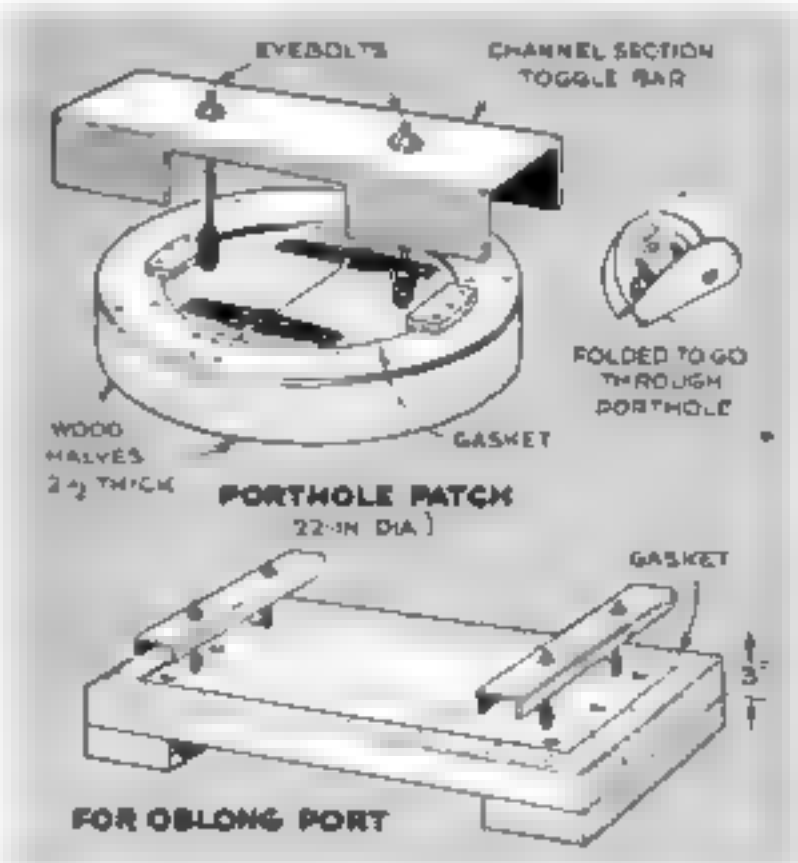
Saving a Ship

Salvage Engineers Are Using All Their Tricks to Give Us Back the Mammoth Normandie

By BERNARD WOLFE

CONFRONTED by the biggest ship-salvage job in marine history, the experts assigned to raise the former French liner *Normandie* from the mud of New York's North River had to start literally at the bottom by setting up their own school for divers. Under war conditions, the 100 or more underwater workers needed for the job simply could not be found. Right at the pier where the mammoth luxury ship (now the U. S. S. *Lafayette*) lay on her side, Navy enlisted artificers were instructed in the rudiments of diving and underwater salvage. At the same time, young naval officers graduating in engineering were rushed through a special course in naval architecture

PORTHOLE PATCHES offer an ingenious solution for the problem of sealing up the countless small openings in the ship's side

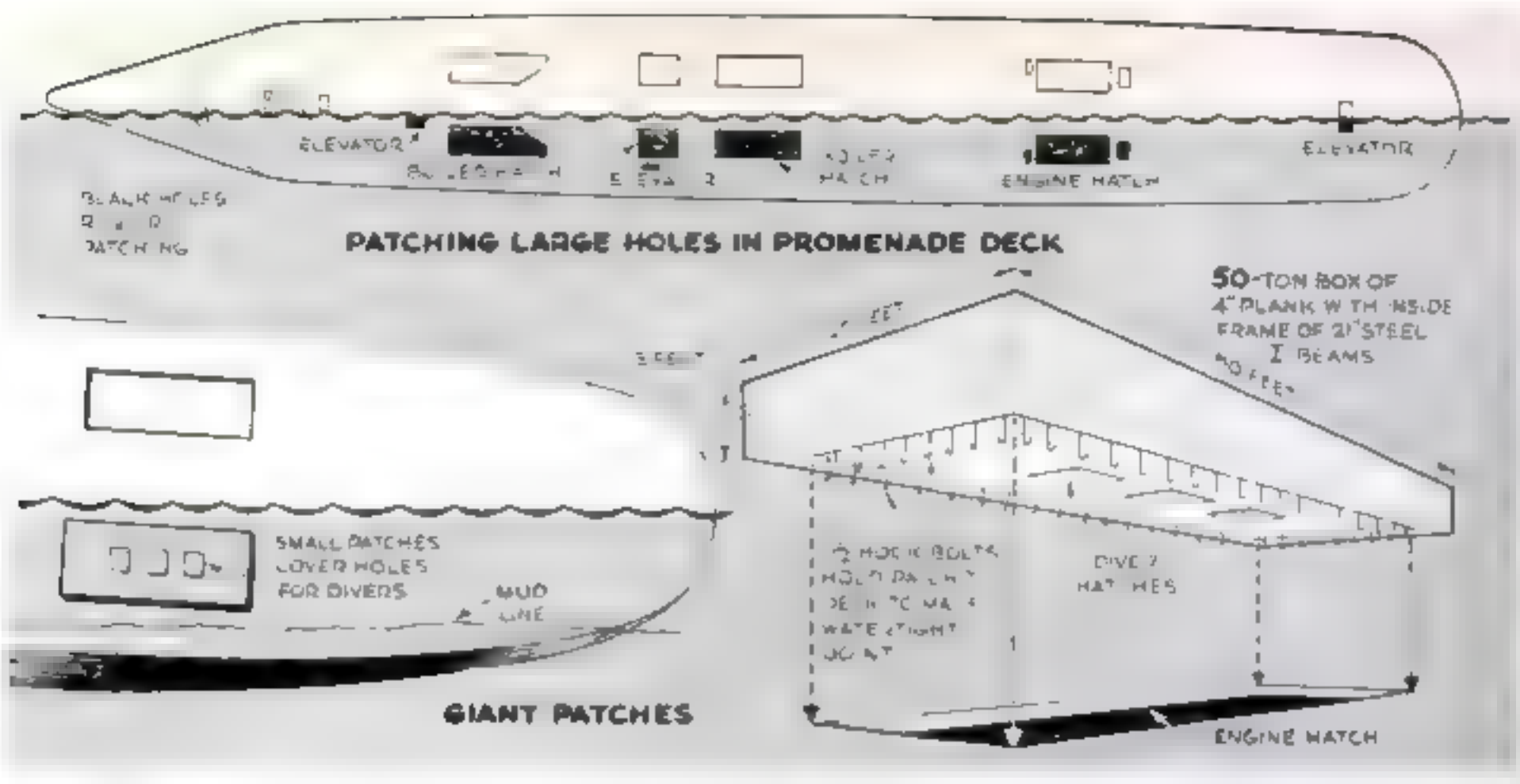


Down the hatch goes a diver for the difficult feat of inserting a porthole patch in 50 feet of water

for Uncle Sam

Folded like this, the hinged patch is laboriously passed through the porthole by a diver. Then it is opened and pressed against the opposite surface . . .

. . . where it is fastened tightly by means of a toggle bar. Cement is then poured into the hole, filling it up to the toggle bar for a watertight seal



DECK PATCHES seal hatches and other large openings below the present water level on the promenade deck. The largest of these, designed to cover engine and boiler hatches, are constructed as shown above. Locked to the deck over the hatches, they provide smaller openings through which the divers can descend

to serve as junior foremen on the big job.

To complicate the task, the only complete set of blueprints of the mammoth ship had been aboard when she burned and sank. Those that could be recovered were drawn up in the metric scale used by French designers. For weeks the engineers had to mark time while more than 500 workmen explored the 1,029-foot vessel inch by inch, the divers working by touch since the silt in the water was so thick that even powerful underwater lamps could not pierce it.

It soon became clear that salvaging problems never before raised had to be solved. For one thing, the after portion of the ship was bedded in soft mud whose maximum bearing capacity in some places was less than the pressure exerted by the heeled-over vessel. In addition, the layer of bedrock at the bottom of the slip rises toward the shoreline at a uniform grade until it reaches a level of 46 feet below low water at a point about 250 feet aft of the bow, then continues to the bulkhead line at the head of the slip with a uniform level of minus 46 feet. The top of the mud line in the slip occurs at about minus 36 feet, but samples taken from this level down to minus 43 feet showed the mud to be of very liquid consistency. Although the greater portion of the ship's weight was resting in mud, there was found to be a considerable concentration of load at the edge of the rock shelf.

Engineers soon discovered that the ship's original position was unstable. Transit records taken at regular intervals indicated that the stern was constantly settling deeper in the mud, while the bow showed a corresponding rise. The fulcrum of the motion was at the edge of the rock shelf.

There are at least 20 different ways of salvaging a ship. The engineers working on the *Lafayette* had to choose between them, bearing in mind the special conditions prevailing at Pier 88. Obviously, they could do nothing that would disturb the mud in the slip, since the ship's position was already so precarious. The immediate job was to lighten the stern or restore some lost buoyancy quickly to the middle portion, as well as to re-establish enough buoyancy to eliminate the concentrated loading at the edge of the rock shelf. After weighing the pros and cons, the engineers finally cast their votes for the method of controlled pumping, whereby watertight compartments are erected within the ship and then carefully emptied in predetermined sequence so that the list and trim of the vessel as it is floated and righted will be subject to control.

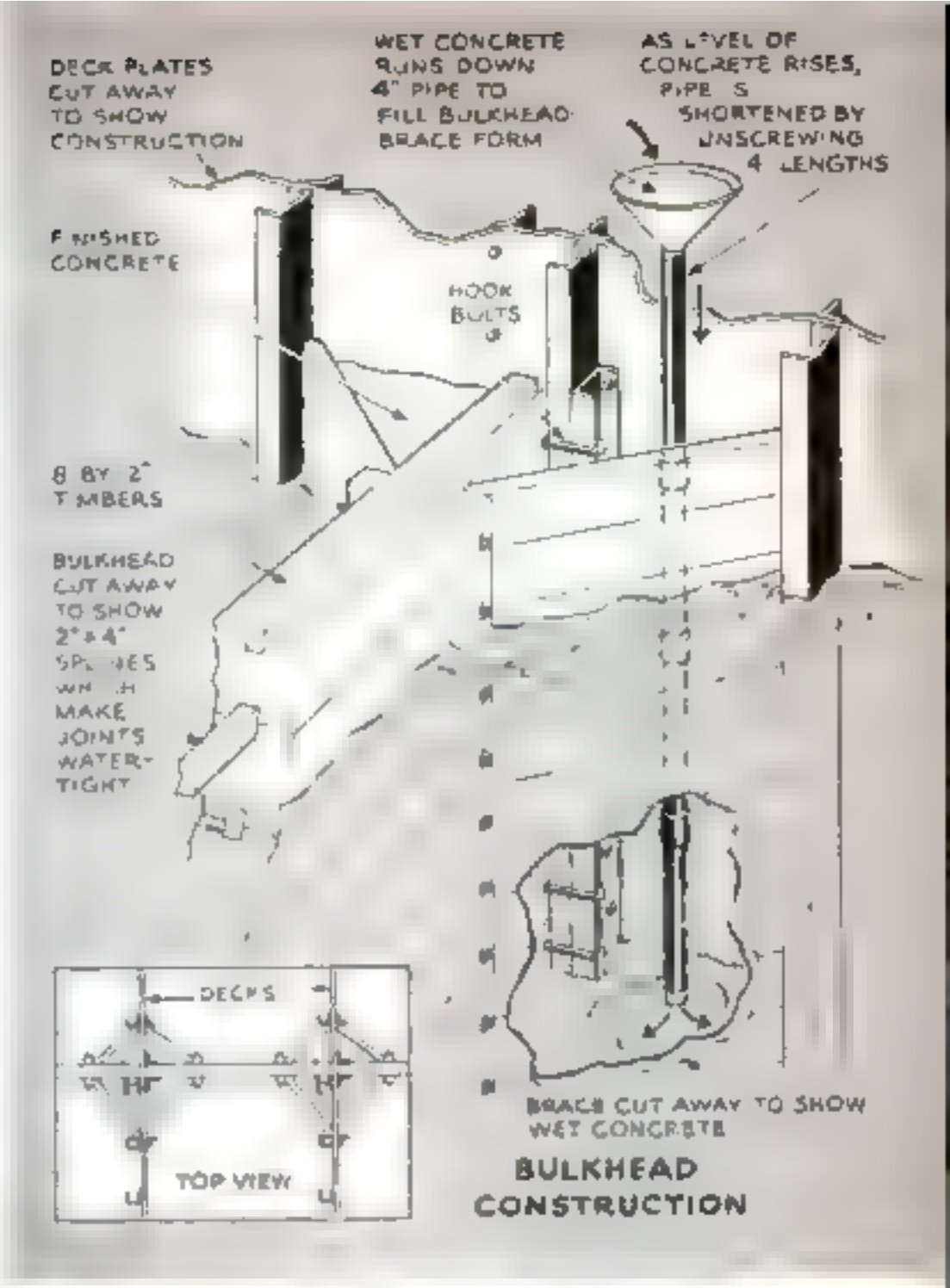
This method, while quicker and more certain of success than any other, involves a vast number of preliminary operations, most of them under water. The vessel's list and trim as it comes afloat will not be controllable unless the movement of the free water remaining in the ship is restricted by both fore-and-aft and transverse bulkheads. Before pumping can begin, all the compartments which are to be emptied must be sealed tight and drain holes must be installed to eliminate fatal water pockets.

However, before any constructive diving operations inside the ship could get under way, underwater compartments had to be cleared of the mud and debris with which they were clogged. When the vessel toppled over, about 10,000 cubic yards of mud entered the hull through open or broken air ports, cargo ports, and deck hatches. To further complicate matters, all the loose furniture, ornamental fittings, and other equipment had dropped to port and mixed with the mud in the ship's lower portion. All this, plus huge quantities of broken glass—the diver's deadly enemy, since it can cut his air hose or rip his diving dress—had to be cleaned out.

Today a great deal of this preliminary work has been accomplished. Many partition bulkheads, ornamental sheathings, and deck insulations have already been cut away wherever they interfere with diving operations. And over 95 percent of the ship's superstructure—practically every item above the promenade deck, including the three great smokestacks—has been stripped away and scrapped, yielding almost 4,000 tons of precious metal. The removal of these top decks has lowered the ship's center of gravity and decreased the magnitude of movement needed to right it.

Now most of the divers are hard at work on the main job, that of sealing up the compartments to be used in controlled pumping. The underwater portion of the promenade deck is being reinforced from the main deck by shores, to enable it to withstand external water pressure when the pumping begins. All of its submerged openings—elevator hatches, air ducts, engine and boiler hatches, as well as countless smaller vents of all sizes and shapes—are being sealed tight from the port side to a point well above the high-tide level, so that the deck will be serviceable as one of the fore-and-aft bulkheads.

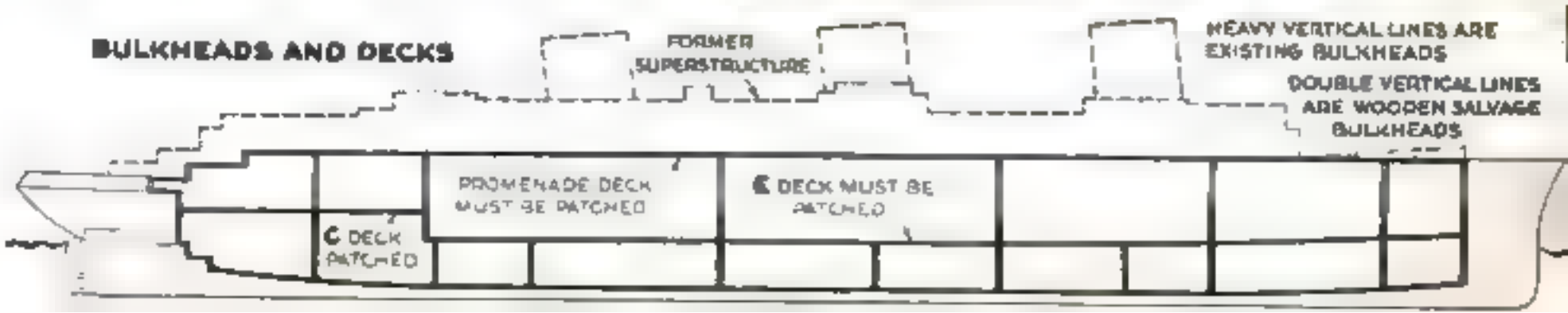
The other deck being used as a fore-and-aft bulkhead is E deck, which in the original design was more nearly watertight than the others, since it was at the water



BULKHEAD CONSTRUCTION

BULKHEADS of wood are constructed by divers where needed to supplement those in the ship's structure. Drawing and photograph show how they are built and anchored to the steel sides. By breaking up the longitudinal compartments as shown below, they will control the flow of water

BULKHEADS AND DECKS



line and sealed in sections as a precautionary measure. With the complete sealing of the port sections of the promenade and E decks, the ship will be divided longitudinally into two compartments running from bow to stern. These long chambers will, in turn, be broken up by a series of transverse bulkheads.

Practically all the *Lafayette's* original transverse bulkheads, except for a few near the ends of the ship, were built up as far as E or D deck, that is, just up to, or one deck above, the water line when the ship was afloat. But now, since the ship is over on its port side at a 78-degree slant, the original transverse bulkheads have to be extended right straight through to the promenade deck, then reinforced and built up above the present low-water level, which on the port side is almost halfway up the 110-foot-wide promenade deck. When this huge job is finished there will be eight transverse bulkheads extending clear out to the promenade deck, spanning the entire nine-deck depth of the ship, and four more going up as far as E deck.

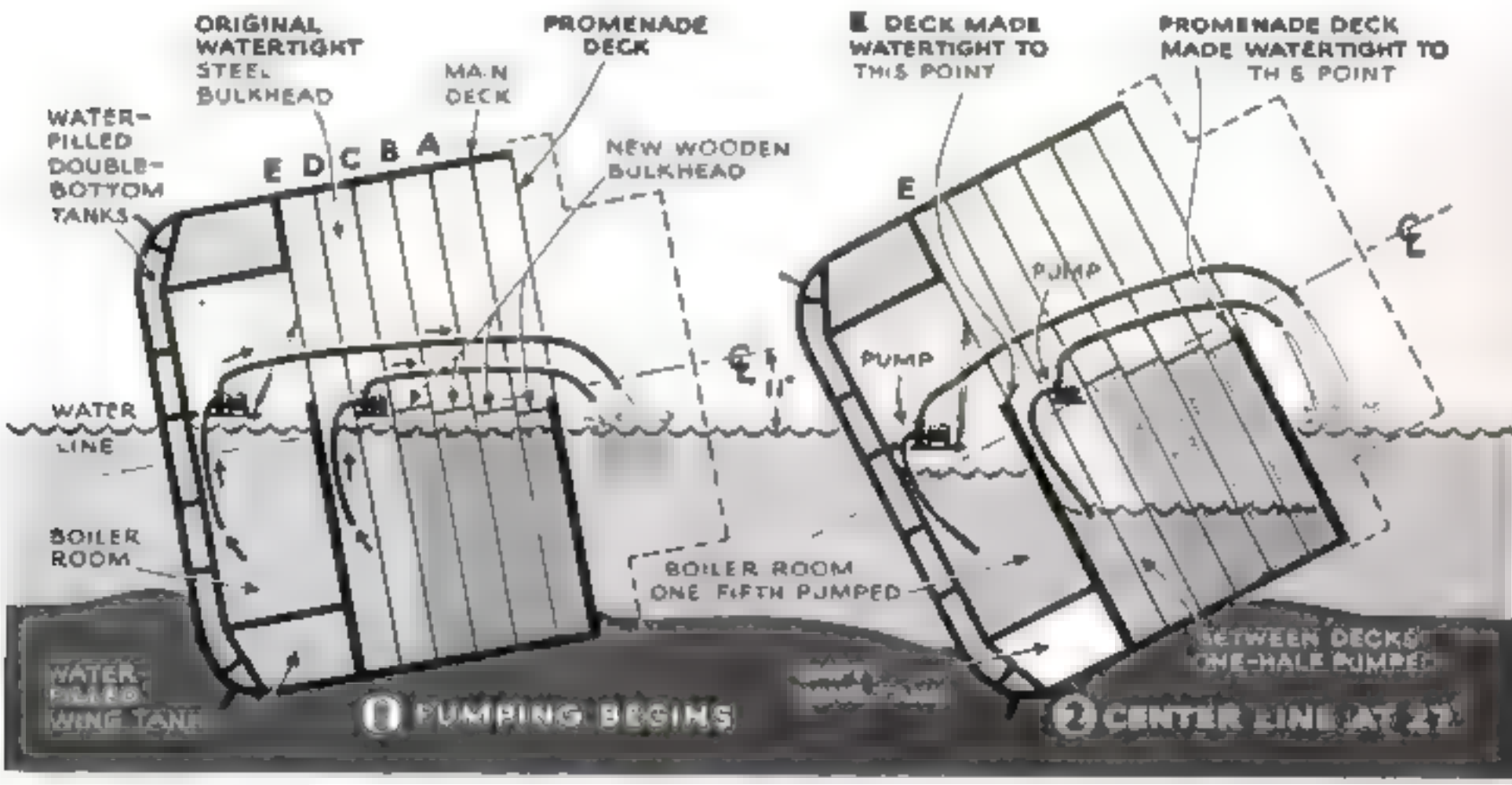
Building these bulkheads is the biggest construction item, but another engineering headache comes from the thousand-odd vents found in all locations on the ship. In addition to the approximately 375 air ports, 14 cargo ports, and miscellaneous scupper and drain pipe openings and hatches now under water on the port side, there are about 500 various openings in the port side of the promenade deck alone which must be blanked off.

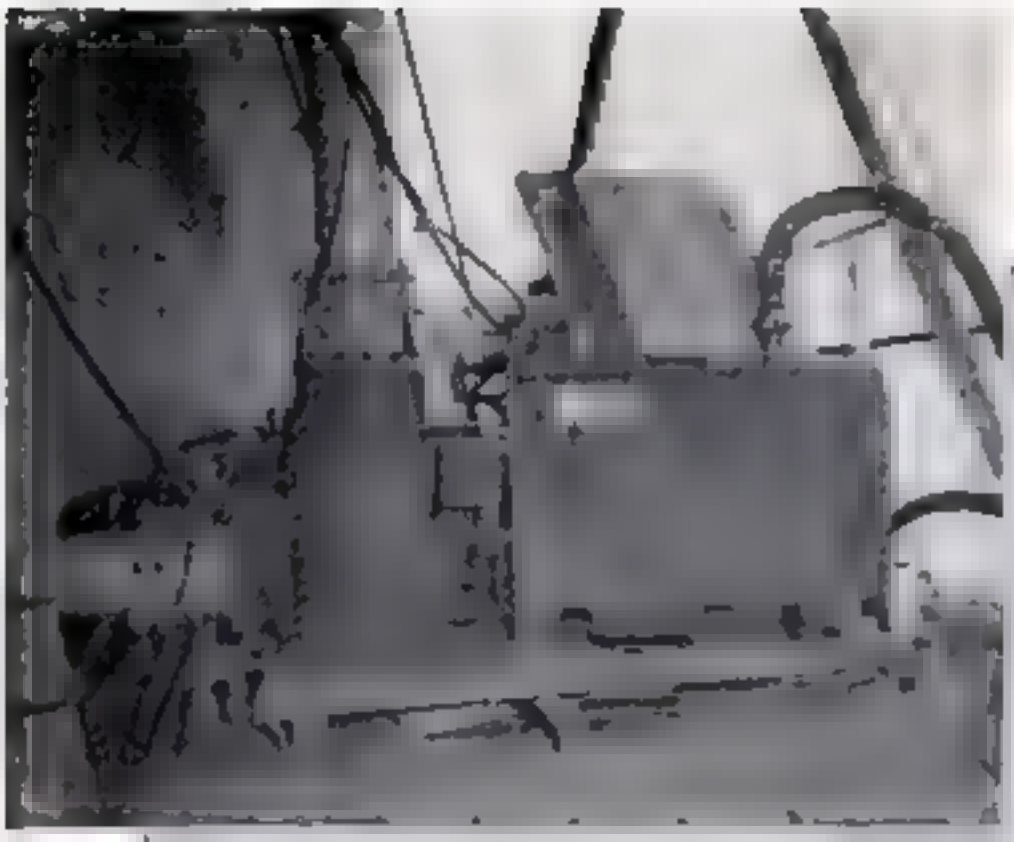
When all the preliminary stripping and bulkhead construction is finished, pumps will be installed and the raising of the vessel will begin. With a system of suction and discharge pumping, controlled quantities of water will be removed from the numerous watertight chambers, starting down near the bow to increase the buoyancy at that point until the ship floats clear from the rock ledge on which it now rests. At the same time, or immediately following, the buoyancy aft and amidships will have to be increased to prevent the rest of the ship from nosing deeper into the mud.

Once the ship is completely afloat, the pumping will be altered to cause a listing movement that will bring it upright again. During all these complicated pumping operations, the wing and double-bottom tanks which line the ship's keel will be used as supplementary controls, as well as all the chambers built up by bulkheading and sealing off the decks.

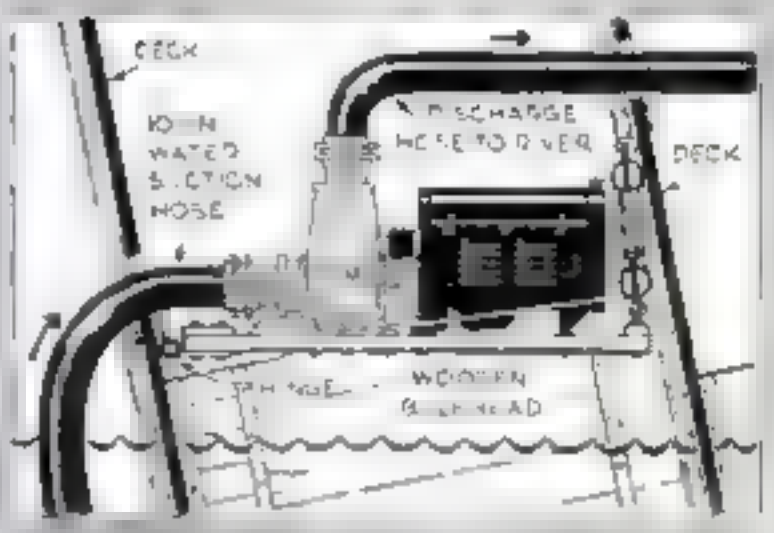
When the prostrate *Lafayette* is floated and righted again, only half the battle, although the toughest half by far, will have been won. It will take many more months before she is reconditioned and fitted out for whatever war duties are assigned to her. But in the meantime, invaluable experience in salvage is being gained by the hard-working experts who swarm over the vessel's barren, rusted hull and feel their way through its muddy depths. This experience will augment the number of trained salvage personnel in the service—a valuable addition to our fighting services.

RAISING is the crucial operation for which all others set the stage. As water is pumped from the watertight compartments, the ship will slowly right itself and rise from its bed in the river-bottom mud

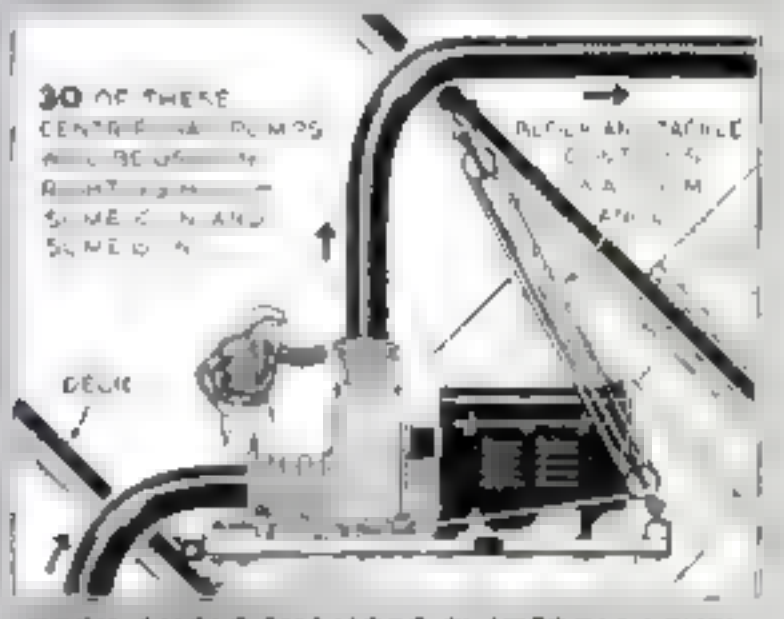




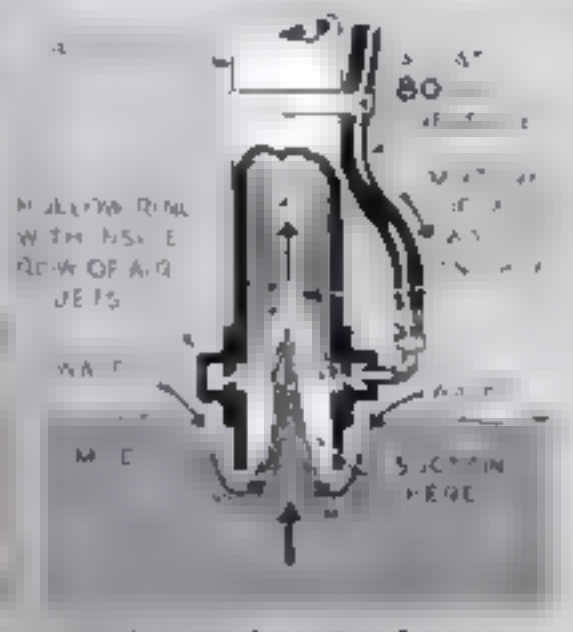
PUMPING will be done by units mounted on hinged platforms set near the water line and adjusted to changing angles as the ship rights itself. Air pumped to hose intakes will suck water to pumps which will discharge it on the outside of the vessel



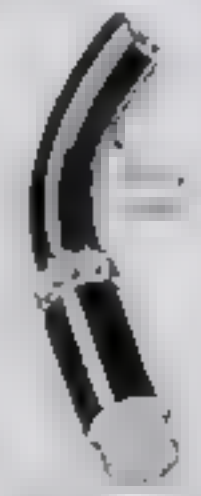
PUMPING BEGINS WITH PLATFORM LEVEL



DECK ANGLE CHANGES, PLATFORM LEVEL

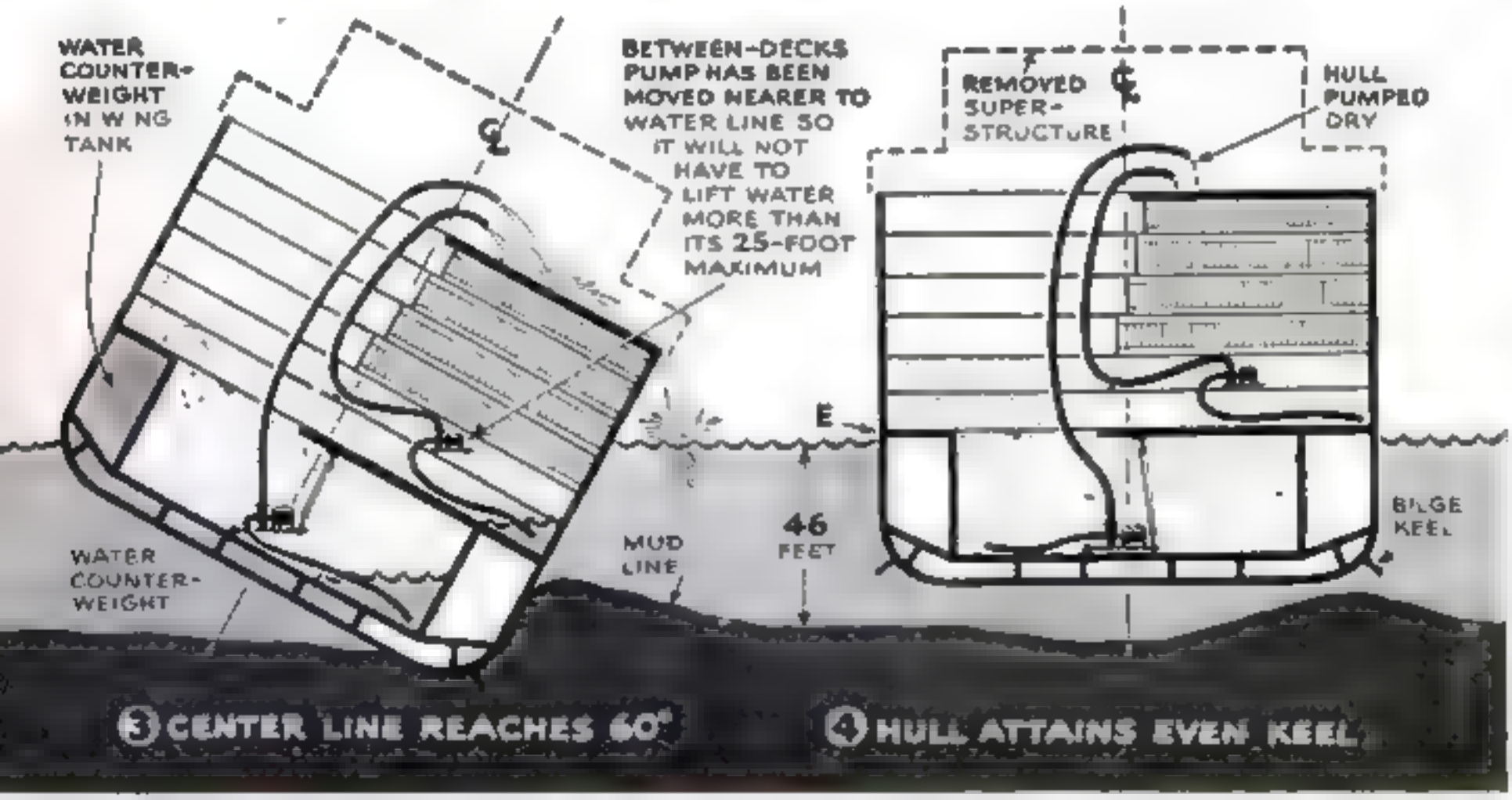


AIR LIFT PUMPING MUD

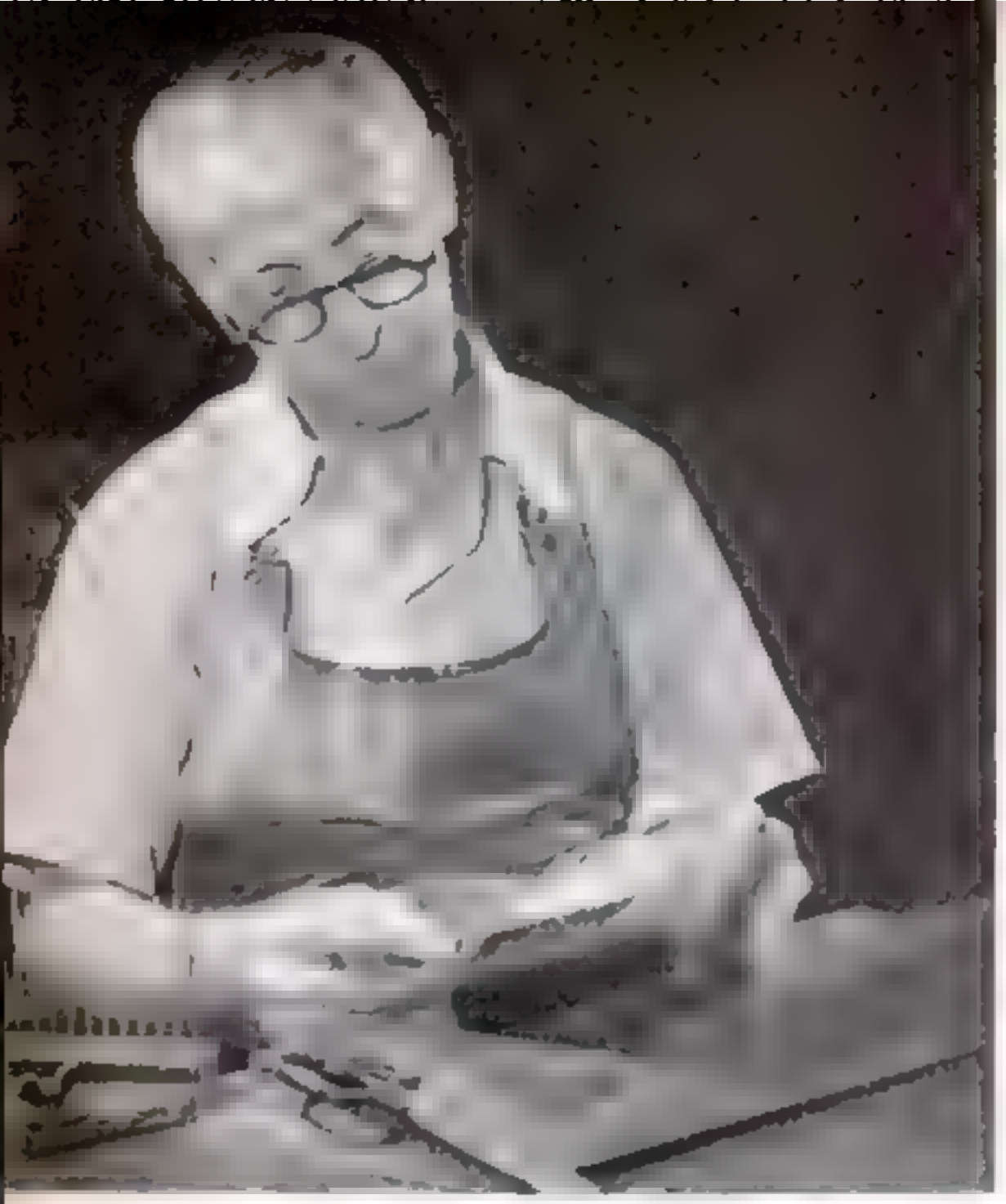


STRAINER AT END OF WATER-PUMP HOSE

Water counterweight in the starboard wing tanks will help bring the vessel to an even keel. As the center line approaches a 60-degree angle with the horizontal, between-decks pumps will be moved farther to port side



Brush



Fine brushes come only from skilled hands. This old-timer has worked at the same bench for over 40 years. At the right is a magnified comparison of natural pig bristles with Du Pont's new Nylon product. Natural bristles have "flag (split tips)

By ALBERT Q. MAISEL

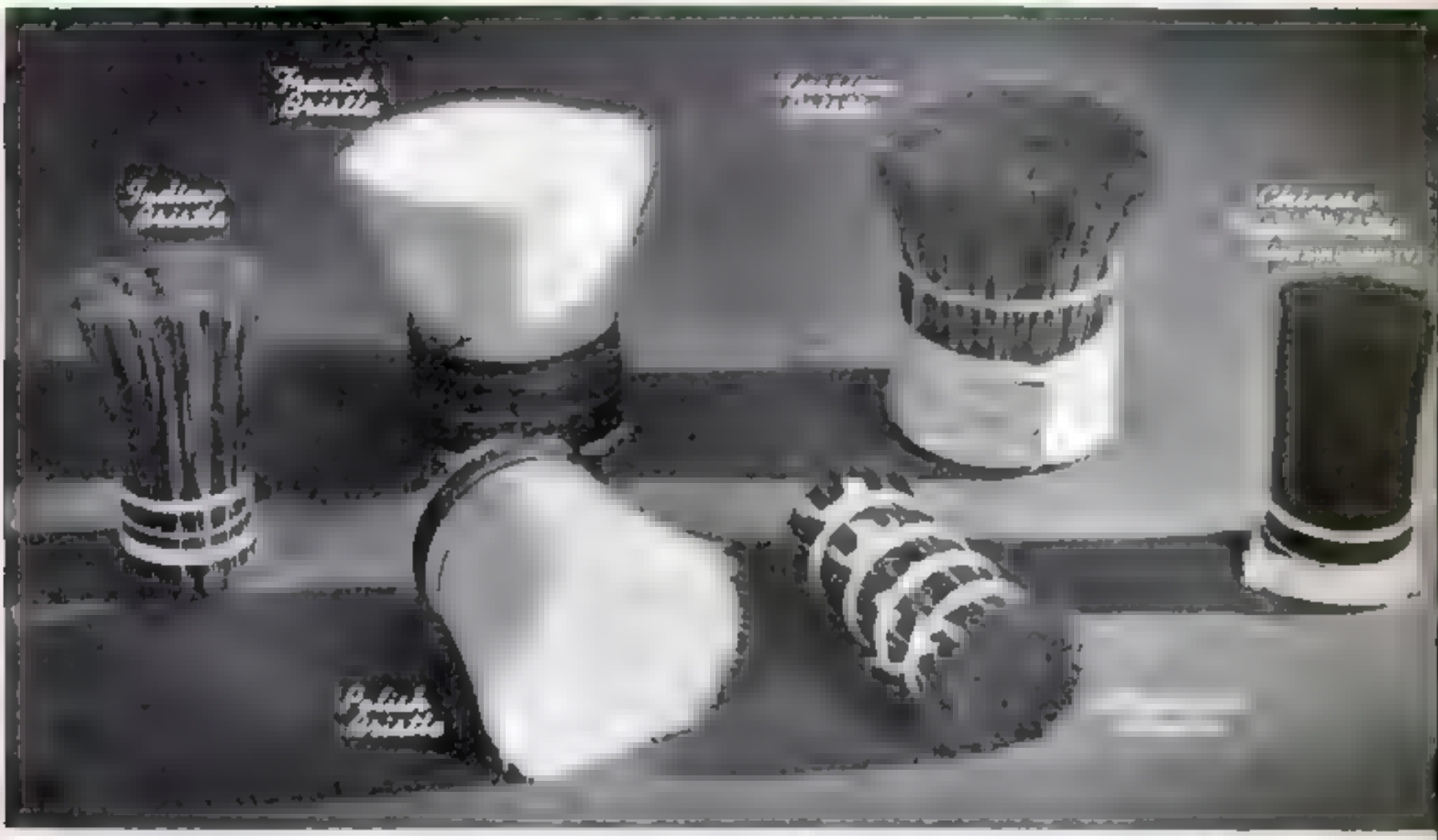
GOOD news for painters is the announcement that Du Pont chemists have succeeded in producing a synthetic Nylon paintbrush bristle with the taper, resiliency, and toughness of the natural material. Natural bristles are normally imported from China, India, France, Poland, or Russia.

The paintbrush we take so much for granted is the product of an age-old craft modified only to a limited degree by modern industrial techniques. Almost every item that goes into a fine brush is under some form of restriction today—a reason for conserving the brushes you now have

The heart of the brush is, of course, its bristle. The finest bristle is built by nature along the lines of a flag pole. At the root end, it is thick and springy. It tapers evenly until, at the other end, it breaks into what brushmakers call the "flag." It is for this reason that pigs' bristles are ideal for paint brushes, for only the pig produces a bristle that is naturally split, at the tip, into from three to six separate sections, each about

BRUSHMAKER'S TOOLS. Unlike highly industrialized trades, the making of paintbrushes is a 1,000-year-old handicraft which still follows the traditions of the old-fashioned artisan. Brushmaker's "tool kit" consists simply of a knife, two combs, scissors, rule, and a mallet

Up on Brushes



Prior to the war bristles and hair for brushes came from all over the world To conserve bristle stock on hand, the Government has ordered brushmakers to mix horsehair with bristle in the proportion of 45 55

half an inch in length It is these flag sections that make a fine brush work without streaking the paint

The nearest natural approach to pig's bristle is found in the hair from the tails of wild Argentine horses But such hair, cut from 28-inch sections of tail, naturally possesses no flag. To remedy this defect, brushmakers apply an artificial flag to horsehair by inserting it into a shredding machine, the revolving spokes of which "split hairs" by cutting each hair end into several flags Since no new bristle now comes from China, the Government has ordered all brushmakers to mix horsehair with their bristle, in a ratio of 45 to 55 so that existing stocks may be spread to take care of vastly expanded wartime brush needs. A number of manufacturers have developed artificial bristles, but the stumbling block so far has

FROM RAW BRISTLE TO FINISHED BRUSH IS THE WORK OF EXPERTS

1 Bristles are here being put in a gas-heated drying oven to straighten out their natural curve or bend which tends to make a brush mat and tangle. Prior to this operation, the bristles, tied into bundles, have been boiled in large vats for a period of three hours. Under the forced currents of hot air of the oven, the bristles gradually dry out straight and true

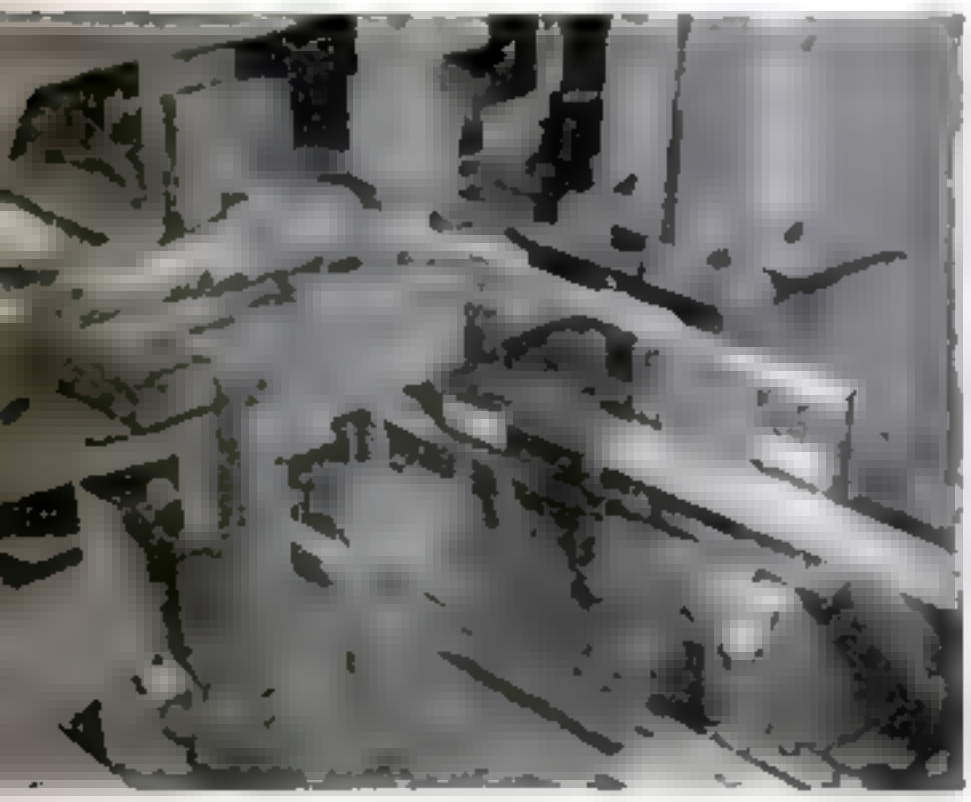
Photographs made at Baker Brush Company by Robert Smith

been to give them the necessary taper.

Imported bristle has a natural bend which must be removed before it can be used for brushmaking. Thus the first step in the process of manufacture calls for the boiling of the bristle bundles. The tightly tied bristles soften under prolonged boiling. They stiffen again when dried in the hot, circulated air of a gas-fired oven, drying straight and true.

Since brushes for different purposes must possess differing qualities, various types of bristle, differing in length and texture, are mixed for each type of brush. By using several lengths of bristle, the brushmaker gives his product a greatly extended useful life, for the flag wears off the longest bristles first, only to uncover the shorter bristles with their flag ends intact. Another reason for mixing

2 On the endless belt of this mixing machine bristles of varied texture and length may be assembled to give any desired set of qualities in a brush. Six to twelve runs through the machine are required. High-speed combing mechanisms keep the bristles in alignment

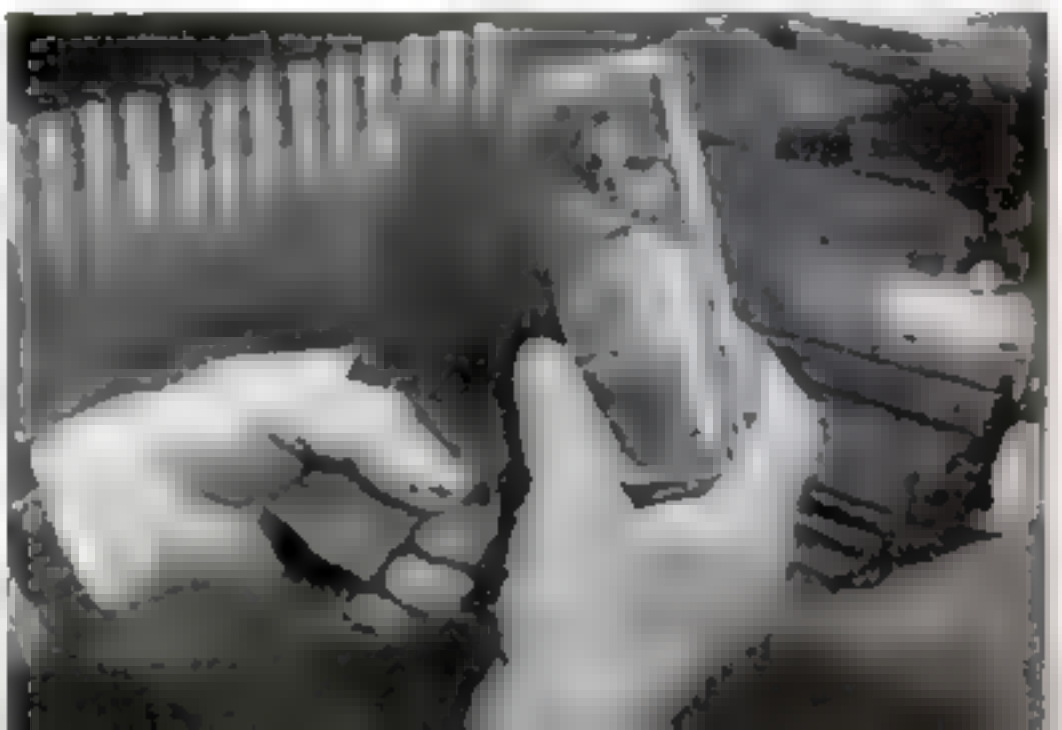


3 Blank ferrules are being fed into this shaping machine which turns and locks their ends to form a perfect flat oval. Later, ferrules will be stamped with trademark, brand, size markings

4 Once the hair has been properly processed and the ferrule is ready to receive it, the initial step in the actual process of brush making is to weigh out the precise amount of hair required

5 Fixed to the brushmaker's bench is a metal comb of twelve flat brass spikes. With a practiced twist of the wrist, the brushmaker realigns the hair by pulling it through the comb

6 The next step is to insert the "knot" of hair into the ferrule which, following the shaping process, has since been riveted or soldered in order that the bristles may have sufficient support



bristle is that bristle with the finest flag may prove too pliant and soft. By adding a small percentage of stiffer bristles, the brushmaker provides adequate body and resilience.

The primary mixing process, known as "laying the bristle," is a hand operation, conducted by skilled "hair hands." The different colors, grades, and lengths, including now the required amount of horsehair, are placed layer over layer on a large table. The art of spreading the hair and bristle seems simple to an onlooker, but only men with years of practice can handle the bristle without getting it all matted and out of direction. The "laid out" bristle is next placed in a mixing machine which carries it over and over again through a series of belts. As the "mix" passes a mixing point, a reciprocating-arm mechanism drops the bristle from an upper to a lower belt, the continuous dropping action mixing the hair more and more with every operation.

The ferrule, the metal band which connects the bristles to the brush handle, is meanwhile formed on automatic machines. The best ferrules are made of brass or nickel-plated or tin-plated steel. Cheaper ferrules are sometimes made of so-called "black plate," an uncoated steel sheet.

Ferrule and bristles meet at the brushmaker's bench, where the master craftsmen of the trade actually form the brush. The brushmaker's tools are simple: a metal-faced bench, a scale to weigh out the required amounts of bristle, combs to straighten the hair, a knife, sciasors, a ruler, and a mallet. You can buy them all for two dollars. What you can't buy is the years of skill with which he quickly converts hair, bristle, and metal into a fine painting tool, each bristle in its proper place, each extending the right length from the ferrule.

The most skilled of all brushmakers are

7 Here the ferrule is being pushed down to within an inch of the butt ends. Because bristles taper, the ferrule, which passed easily over the thin "flag" ends, now begins to fit quite tightly

8 Inserting a long, thin wooden plug in between the bristles where they extend over the edge of the ferrule, the brushmaker evens off the butt ends by clipping them with a blunt metal knife

9 On larger brushes, as many as two or three plugs may be inserted. At this point, the brushmaker aligns the bristles with his fingers—a process that requires great manual dexterity

10 A comb with round, parallel brass teeth is used to straighten out the bristles. In case a few still extend beyond the mass, they are removed with scissors or an ordinary paring knife

the "cup chiselers." It is they who make brushes with shaped painting edges, such as master painters use for their finest varnish and trim work. The true chiseled brush is formed by placing the bristle "knot," flag ends downward, into a brass cup. The bottom of this cup is shaped to the exact curve the final chisel edge is expected to take. The cup is beaten with a rhythmic tattoo that makes a cup-chiseling room in a brush factory sound like a jazz drummers' convention. Knocking the cup four times a second or faster against the metal top of his bench, the brushmaker soon causes the bristles to align themselves in conformity with the cup's chisel shape. Then he trims the butt ends of the knot straight with his scissors and inserts the bristle bundle into the ferrule.

Without a setting, the bristle would soon come free from the ferrule, for it is held there by only a one-quarter to one-half-inch overlap. Originally, pitch was used for setting purposes, but this was long since abandoned for shellac which, in turn, has been replaced for the last 20 years or more by vulcanized rubber. Rubber is fed into the ferrule as a thick, gummy mass, measured and dispensed by a machine so that each brush gets precisely the required amount. When the stacked brushes are placed in tray in a vulcanizing oven, they are first heated at 160 degrees F. This causes the rubber to soften and flow into the interstices between the bristles. When the rubber has flowed down to the very edge of the ferrule, in from one to four hours, the oven heat is raised to 275 degrees F. Within 12 to 14 hours, depending on the size of brush being treated, the hardening or vulcanization is completed.

Brush handles are made of hard wood, usually maple. Each shape is traditional, having been worked out after years and even generations of use by exacting master painters. Many other style points in brush-

11 Bristles are forced through the ferrule (held on metal jig) until each is at a fixed level, varying from one quarter to one half an inch. Only this small bit of bristle remains in the ferrule

12 The vulcanizing process begins with a mechanical dispenser feeding out precisely the right amount of rubber. Note the wooden plugs and butt ends of the bristles in the bottom of the ferrule

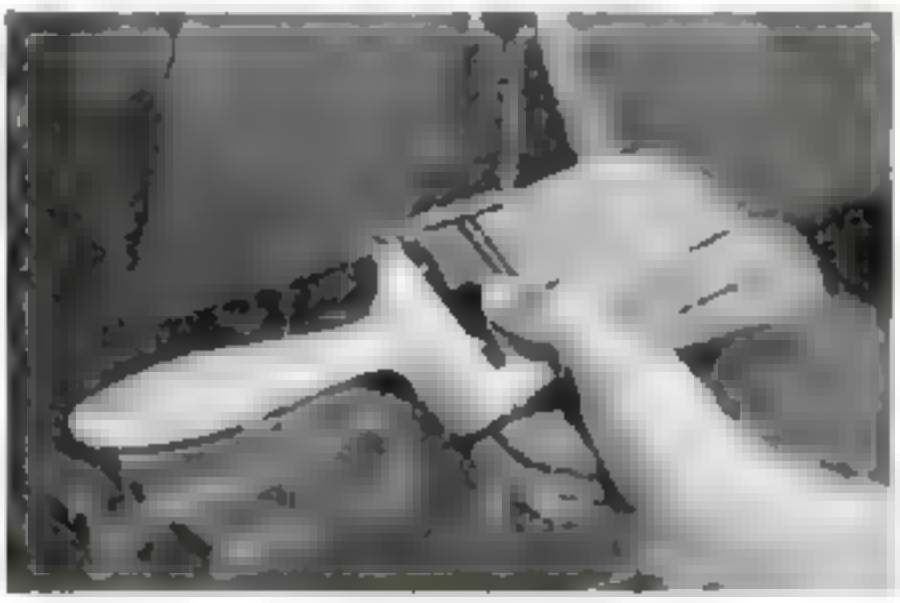
13 Brushes are placed on trays which move ferris-wheel fashion through the 160-degree air of the oven below. After four hours, heat is raised to 275 degrees. Twelve hours later rubber is vulcanized

14 As an added measure of safety for the larger brushes, nails are firmly driven through holes drilled in the ferrule. This locks the ferrule, rubber setting, and the wooden plugs into a tight unit

15 Hardwood handles tapered so as to fit tightly into the ferrule, are hammered into place with a hardwood bar to avoid marring their finish

16 Nailing the handle to the ferrule. Handle shapes are one of the many traditions of the trade dictated by generations of master painters

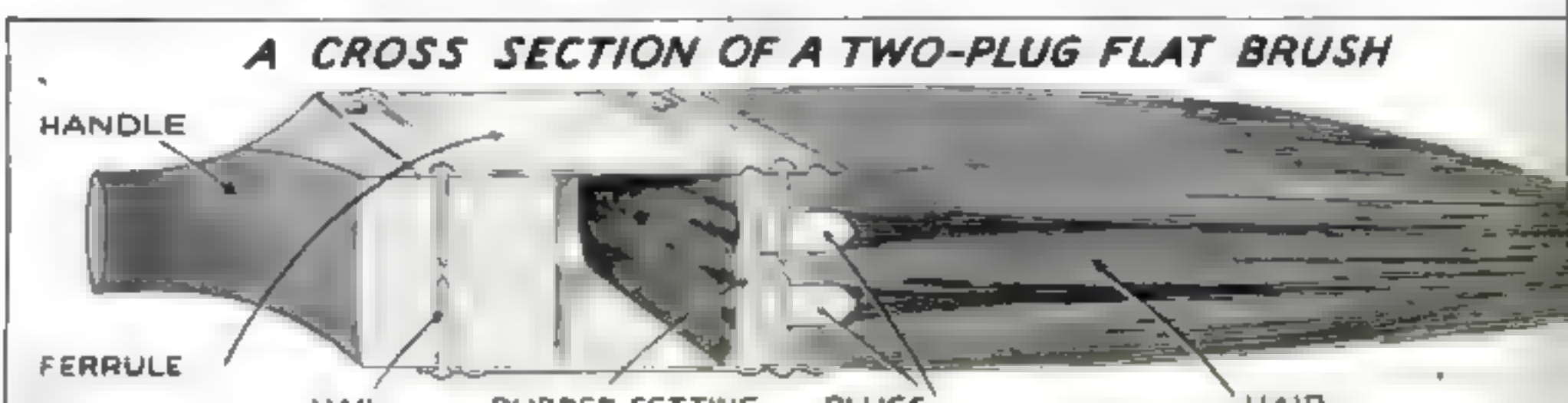
17 Size brand, and grade markings are now stamped on the handle shown below with a hot die which is worked through a sheet of gold or aluminum leaf. This leaf is fed from a roll automatically, the operator merely positioning the brush and pressing a pedal. At right, bristles are wrapped to protect them from dirt and rough handling



making are governed largely by tradition.

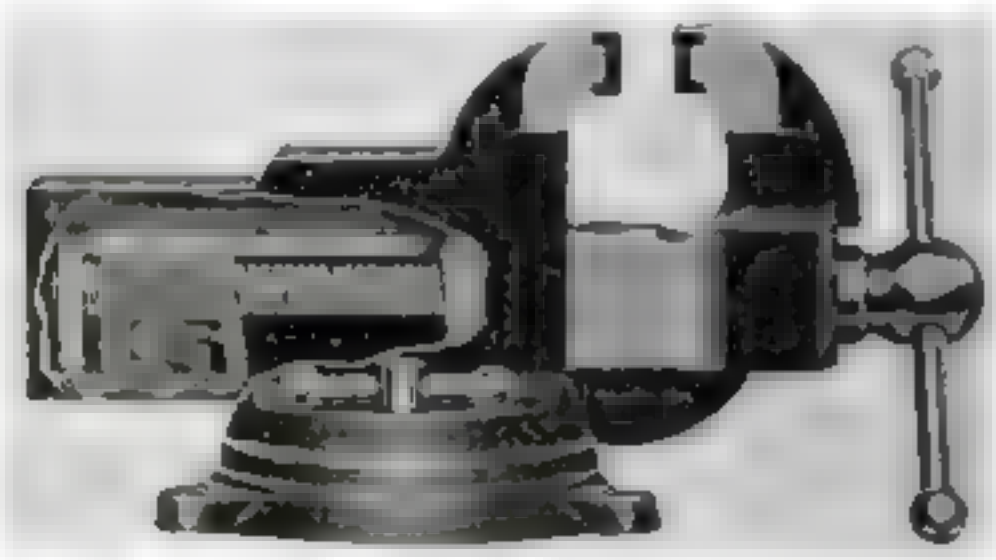
Brushes are made in a bewildering variety of shapes and sizes. In recent years there has been some tendency to simplify and standardize brush sizes, but hundreds of varieties are still made. Flat varnish and enamel brushes find the widest market. These come in widths graded in half inches, providing sizes best suited to virtually all types of work. "Length out," the distance which the bristles extend from the end of the ferrule, is, to a large degree, a measure of brush quality. Naturally, brushes of greater width have longer bristles. But, as between two brushes of equal width, the one with the greater "length out" will generally cost more, work better, wear longer, and do a smoother painting job.

Cross section of a brush is shown below. Brushes are made in a wide variety of styles—due partly to varying usage, but mostly to tradition-bound preference of painters in different parts of the country



new Tools

A RIVET TIMER which can be attached to a portable riveting gun, and which works either automatically or manually, now insures rivet bucktails of uniform height and diameter, and avoids the need of re-hitting or the possibility of overhitting. Time cycles are controlled by dial.



THIS QUICK-ACTION VISE, which slides open and shut like a drawer, can be locked at any position with only two turns of the handle. When the pawl is engaged on the steel rack, as shown, the vise is ready to grip. Two handle turns to the left disengage the pawl and permit free opening and closing of the jaws. When they are in the position desired, two turns of the handle to the right re-engage the pawl, and again the vise is ready to grip.

PIPE BENDS up to 180 degrees can be made without heating or filling with this portable hydraulic bender. Equipped with seven sizes of formers, it can handle both steel and iron pipe, or solid bars of mild steel, from ⅜ to two inches. Consisting of a pipe-holder frame, a hydraulic jack, and a former which is attached to the plunger of the jack, the bender weighs 98 pounds, is 32 inches in length, and can be set up in less than a minute without need of bolting. Less than three minutes is required to produce bends in any size of pipe. The unit can also be used for any kind of pushing or pressing work.

LEVEL GAUGE built into a pencil is one of the latest time-saving gadgets for defense workers, home mechanics, carpenters, etc. The pencil is just as compact and operates in precisely the same manner as any other mechanical pencil.

Science Discovers How Germs Die

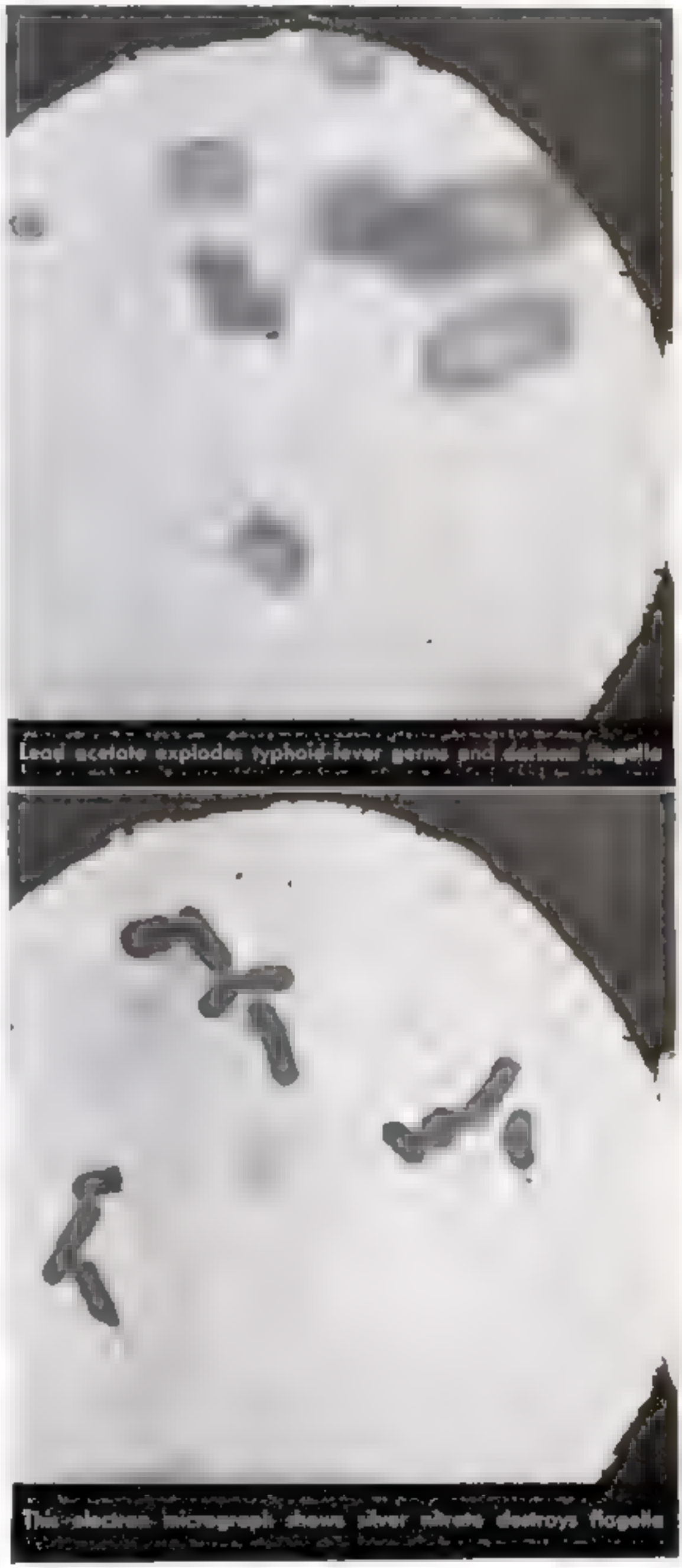
ELECTRON MICROSCOPE OPENS NEW RESEARCH

HOW germ-killing agents, such as silver nitrate and bichloride of mercury, act on the individual disease germs is revealed for the first time in a new triumph of the powerful RCA electron microscope. Dr. Stuart Mudd, of the University of Pennsylvania, and Dr. Thomas F. Anderson, of the RCA Manufacturing Company, collaborating in studies along this line, find that silver nitrate completely destroys the flagella, or propellers, of the typhoid-fever germ, as shown in the lower electron micrograph at the right, while lead acetate —shown in the upper electron micrograph—darkens the flagella but does not destroy them.

Other points of extreme interest revealed by the two electron micrographs are the action on protoplasm, which is the life of the cell. Silver nitrate stains the protoplasm black, and seems to shrink the entire germ, but apparently does not affect the wall of the cell. When mixed with lead acetate, the germ swells, and its protoplasm escapes its wall to form a halo around it

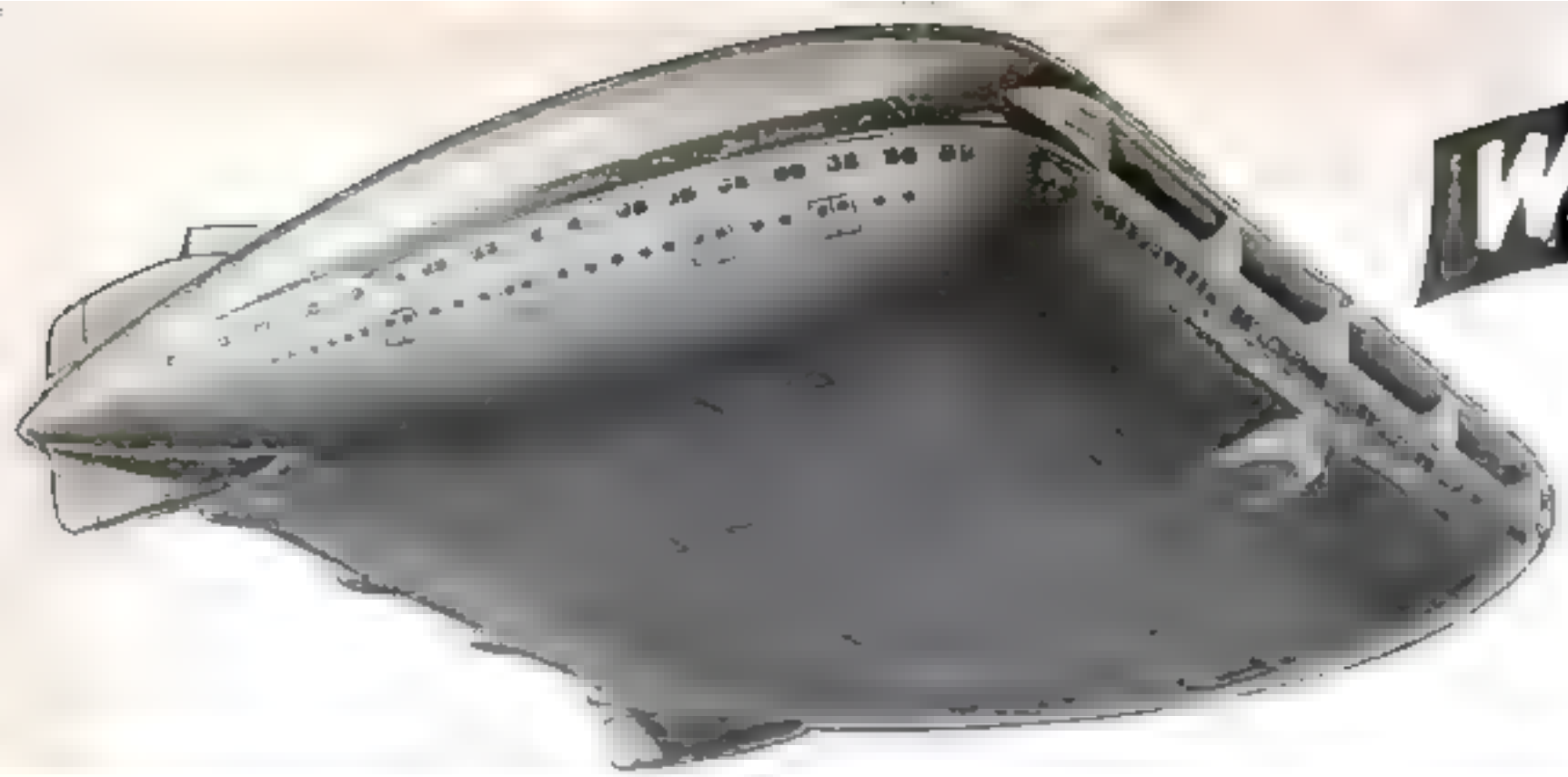
Dr. Mudd and Dr. Anderson also observed the action of lead, silver, nickel, and mercury salts on cholera and dysentery germs and on the microorganism Fusobacterium.

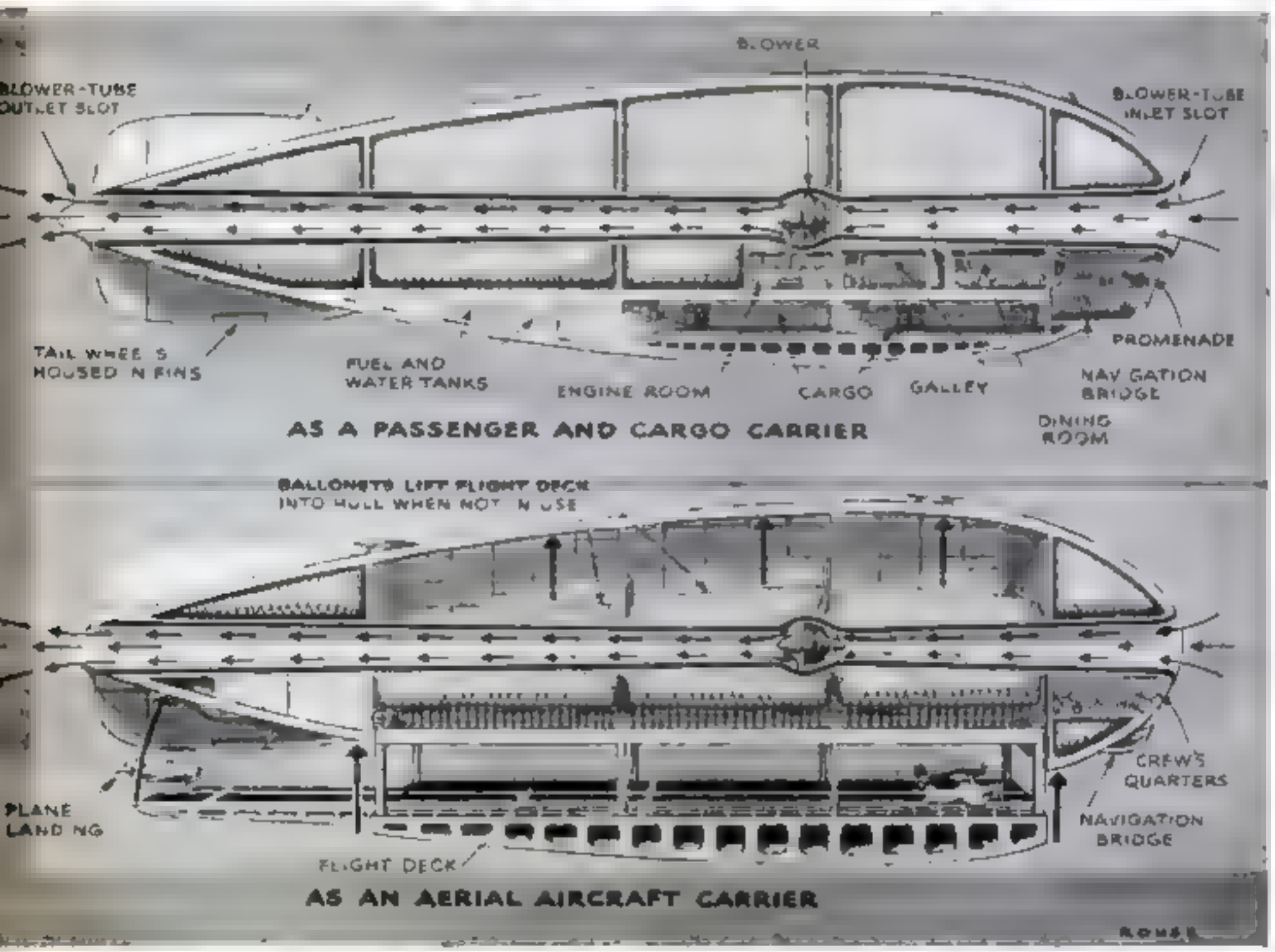
A number of RCA electron microscopes are in operation in scientific fields, including biology, metallurgy, and chemistry, making possible important investigations of bacterial morphology and metabolism, viruses, antigen-antibody reactions, and chromosome structure; of iron and its alloys, brasses, and other metals. The instruments are also used to study particle size and shape, colloids, surface chemistry, thin films, and plastics.



Lead acetate explodes typhoid-fever germs and darkens flagella

This electron micrograph shows silver nitrate destroys flagella





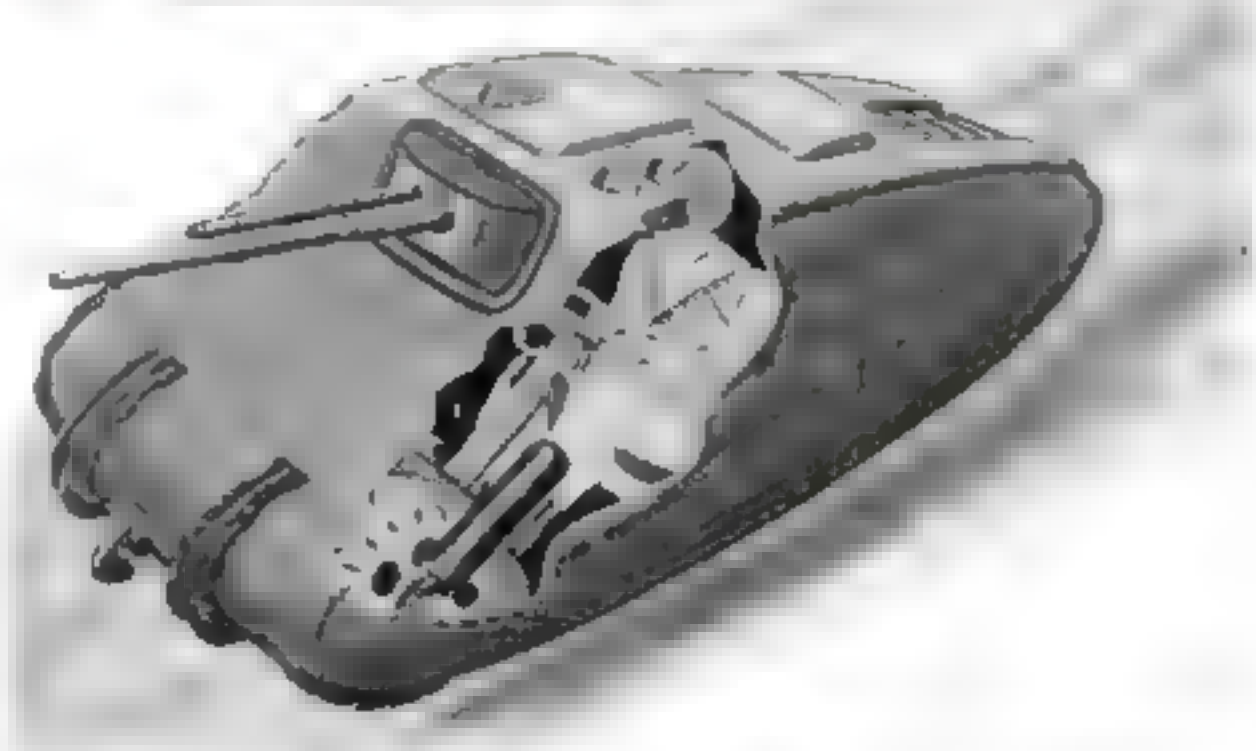
FLYING AIRCRAFT CARRIERS and huge troop and cargo air transports with a range of 8,000 miles have been designed by Horace Chapman Young and Eric Langlands as combinations of airship and airplane. The Airwing, as the craft is called, is built as a flying wing with space within its single-wing body for helium, fuel, crew, and pay load and tunnels in which propellers or blowers operate.

This wind-tunnel operation is based on the principle that the plane will both pull and push itself forward—pulling through suction caused by a semivacuum created in front, and driving by exhaust pressure at the rear. The helium gives it additional lifting power, making a total load of 63 tons possible for a ship 250 feet square and 62½ feet in height. A troop transport of the same size would accommodate 300 soldiers fully equipped for service abroad. The aircraft carrier is designed with a flight deck 180 feet wide by 200 feet long that could be lowered below the hull to allow 12 fighter planes to take off and land.

Maximum speed is estimated at 240 miles an hour, take-off speed at 30, and landing speed at 20. The Airwing could cruise 270 hours at 30 miles an hour.

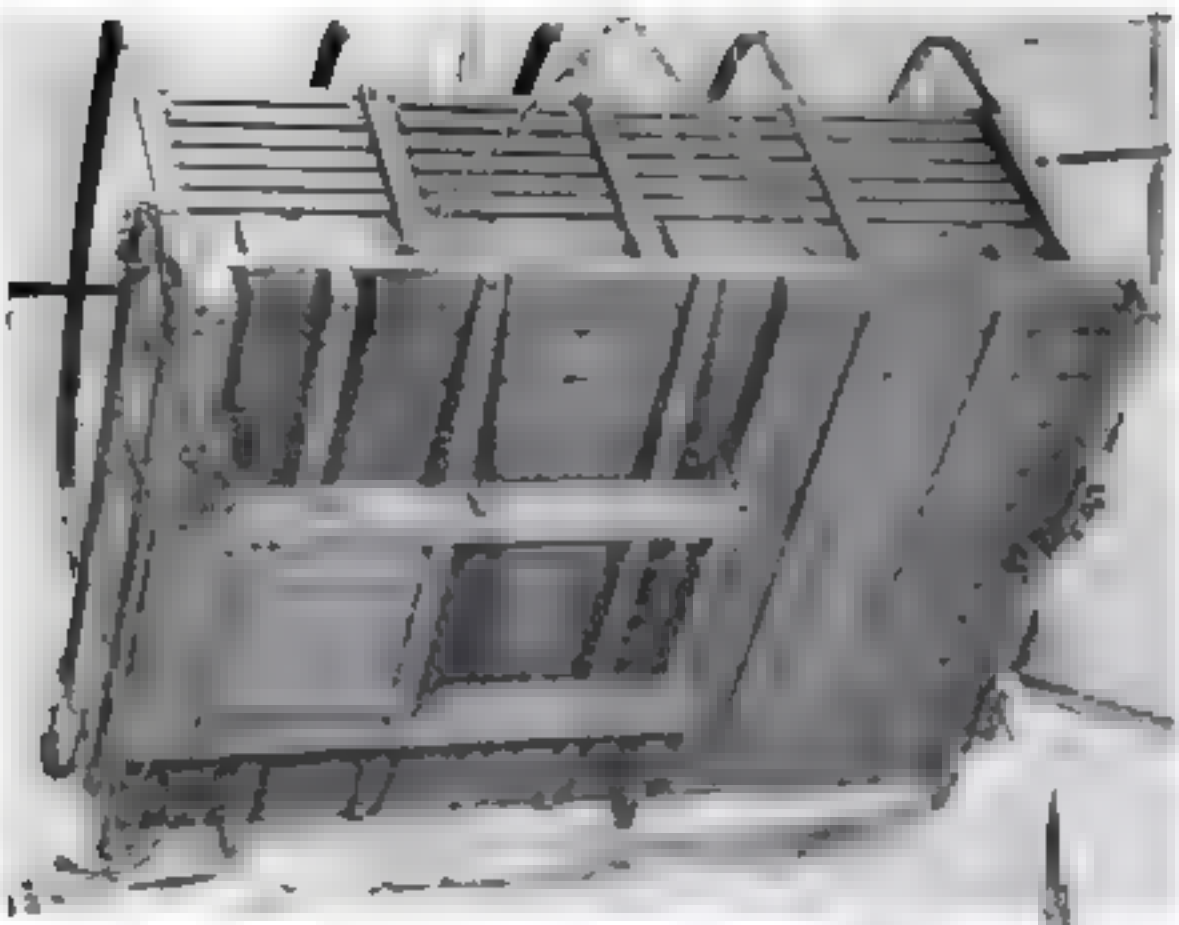
IDEAS

TWO-MAN PARATANKS small enough to be transported in cargo planes are proposed by Martial and Scull, industrial designers, to provide a quick means of landing mechanized equipment behind enemy lines. The all-welded tank at right is triangular in shape with two forward wheels and a track-type runner in the rear. It carries a 37 - millimeter antitank gun coupled with a heavy machine gun. The occupants also have submachine guns and grenades.

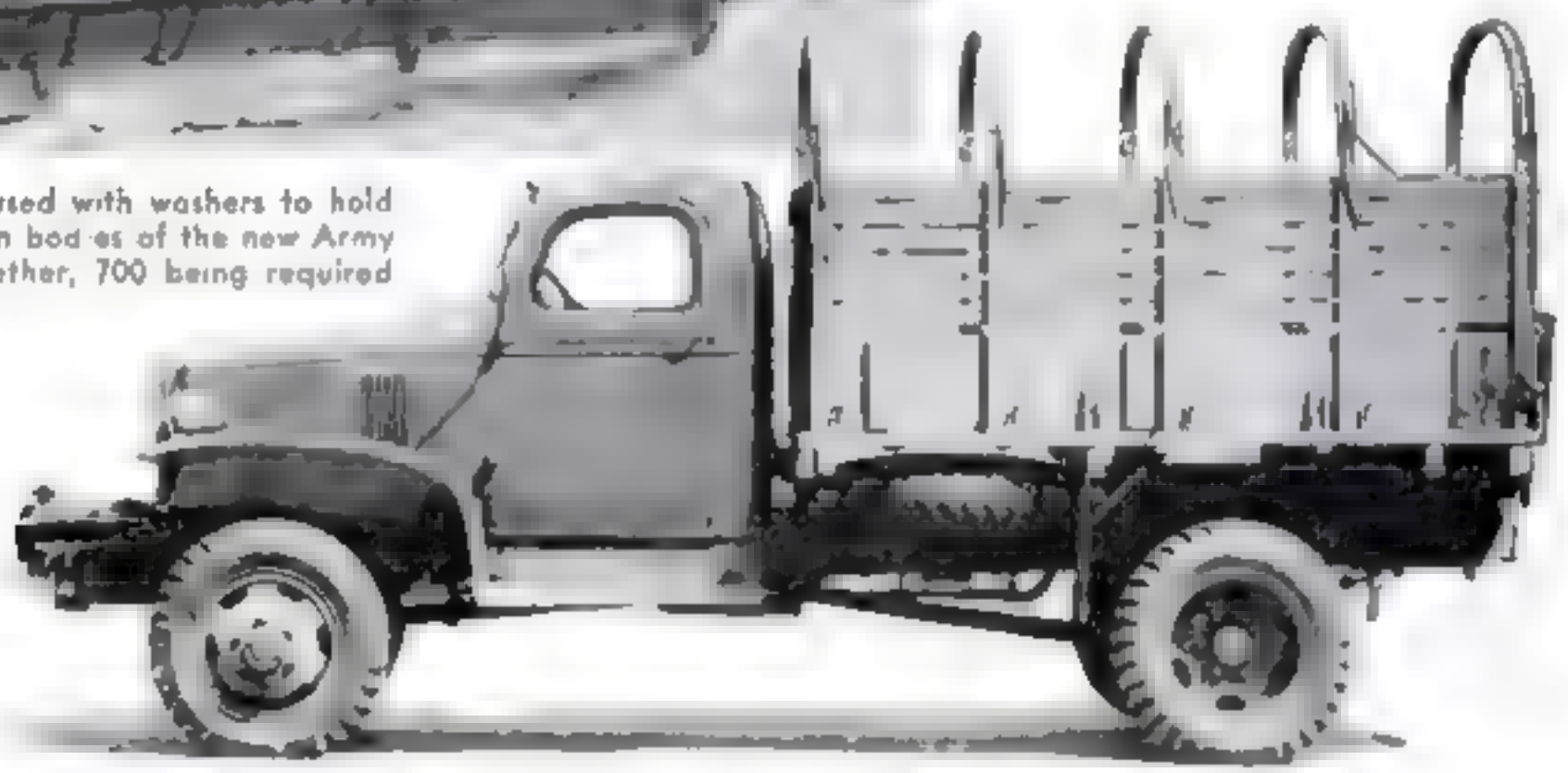


EXTRA FOLDING WINGS on a plane proposed by Byron T. Wall, of Raymond, Alta., Canada, increase the wing area and drag, allowing it to take off and land at the low speed of a biplane and yet retain the longer flight range and high speed of a monoplane when it is in the air. The auxiliary wings are raised before the take-off, giving the plane extra lift and requiring a much shorter run —an important consideration on small fields.

When sufficient speed has been attained in the air, the auxiliary wings are retracted, folding into the fuselage and lower wings and eliminating the drag of struts and extra wing area. Recesses in the fuselage and lower wings cut resistance when the upper wings are folded. In landing, the procedure is reversed, with the upper wings being separated from the lower at an angle beginning at the outer edges. This offsets suction that would tend to hold the wings together if the action were in parallel planes.



WOODEN BODIES are being built on all new Army trucks, making use of materials that are plentiful and conserving metal for more vital purposes. Body longitudinal sills, cross members, side and front panels, and tailboards are all of wood bolted together in the new construction. Troop seats, which were of wood in the old trucks as well, are interchangeable. Metal skid strips cover the floor to protect the boards from wear.



Bolts are used with washers to hold the wooden bodies of the new Army trucks together, 700 being required

DOUBLE-EDGED RAZOR BLADES are sharpened in a few seconds on a new hone marketed by the Marlin Firearms Co., shown above. The stone is curved at the proper angle to hone the cutting edge and is provided with a metal clip that holds the blade in the correct position and applies all the pressure required during strokes. Operation is not mechanical, being entirely by hand.

ELECTRIC GUNS FOR EXPLOSIVE RIVETS are among the latest tools invented to assist in airplane construction and repair. When heat is applied through thermostatically controlled electricity, it sets off a charge in the shank end of a rivet, spreading the cap automatically to make a strong joint that formerly required hammer blows. This method is of particular advantage in riveting plane parts that are hard to reach.

Movable Walls Built of Glass

NEW glass-block partitions, held together with ridged wooden strips instead of mortar, are as easy to take down and move as they are to install. This development will make it possible to change layouts of interiors of homes and office and factory buildings almost at will. The blocks are slotted on four edges for locking on the ridged strips, and at the ends of a wall are anchored in position by a system of wooden wedges. The wooden "mortar" strips may be painted or stained before being put in place, or their edges may be finished later.

With a wooden frame, A, installed on adjoining walls, glass blocks are laid in tiers and held by horizontal and vertical strips, B and C. The rows are locked with wedges, D, as they are laid

Blocks are laid on horizontal wooden strips with vertical, interlocking strips between them, as at left. The result is the translucent partition below

How Medical Soldiers meet the Blitzkrieg

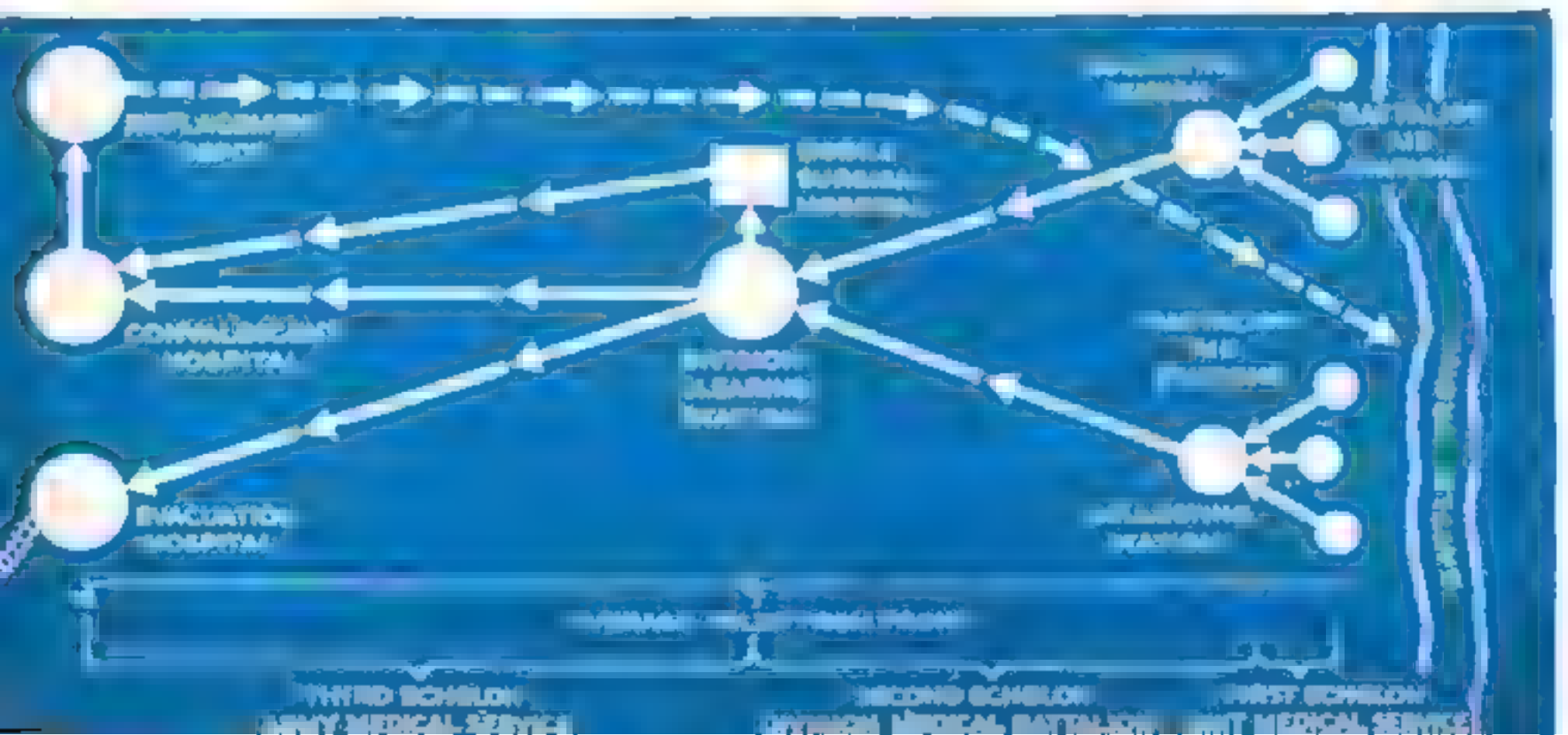
LITTER-CARRYING STRAPS are a part of the regular equipment of today's American medical soldier. When not in use, they are carried in a pouch

PHOTOGRAPHS BY WILLIAM W. MORRIS

MECHANIZED warfare has brought new problems to the Army's Medical Department. Even on a relatively static battle front, like those of the first World War, the task of aiding and bringing back the wounded is a gigantic one. In fluid blitzkrieg fighting, with the tide of battle rolling rapidly over miles of countryside, the medical men must wage a blitzkrieg of their own—in reverse.

Win, lose, or draw, the Medical Department has its hands full. When things go badly, it may find itself responsible for 25 percent of the total personnel engaged in a given sector. When things go well, the percentage of wounded is likely to be less, but the very success of the operation introduces new difficulties. A clearing or sorting station for the wounded which was located six miles behind the front at the beginning of the attack may be 20 to 30 miles behind after a few hours. Yet the medical units are bound to keep up with the movement somehow, for time is precious. The sooner a seriously wounded man can be picked up, given first aid, and evacuated, the better his chances of survival. The farther back he goes the more comfortable he can be made

HOW WOUNDED ARE REMOVED FROM A TYPICAL BATTLE AREA



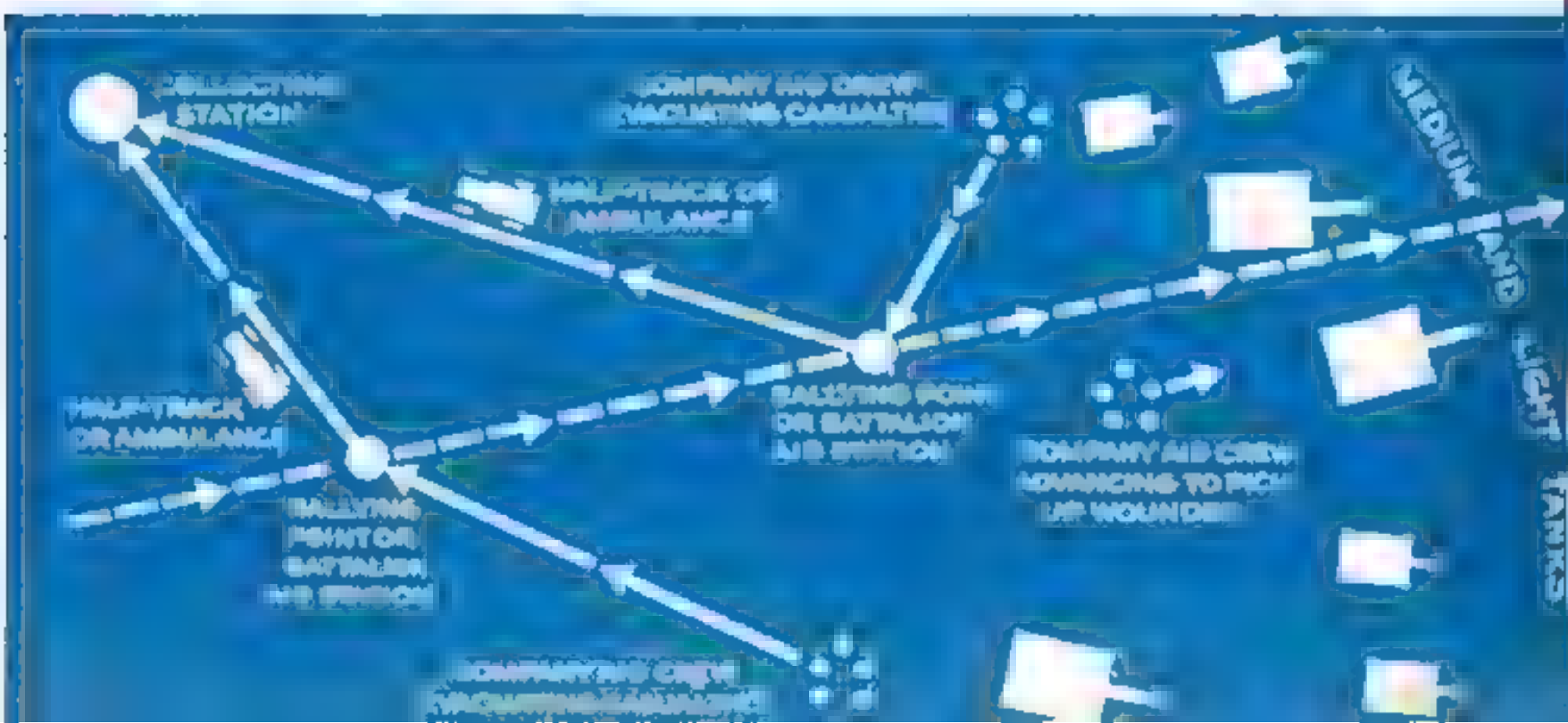
This harness is a great help when wounded have to be carried considerable distances to aid stations and to collecting stations farther behind the lines

and the more adequate the treatment which can be given him.

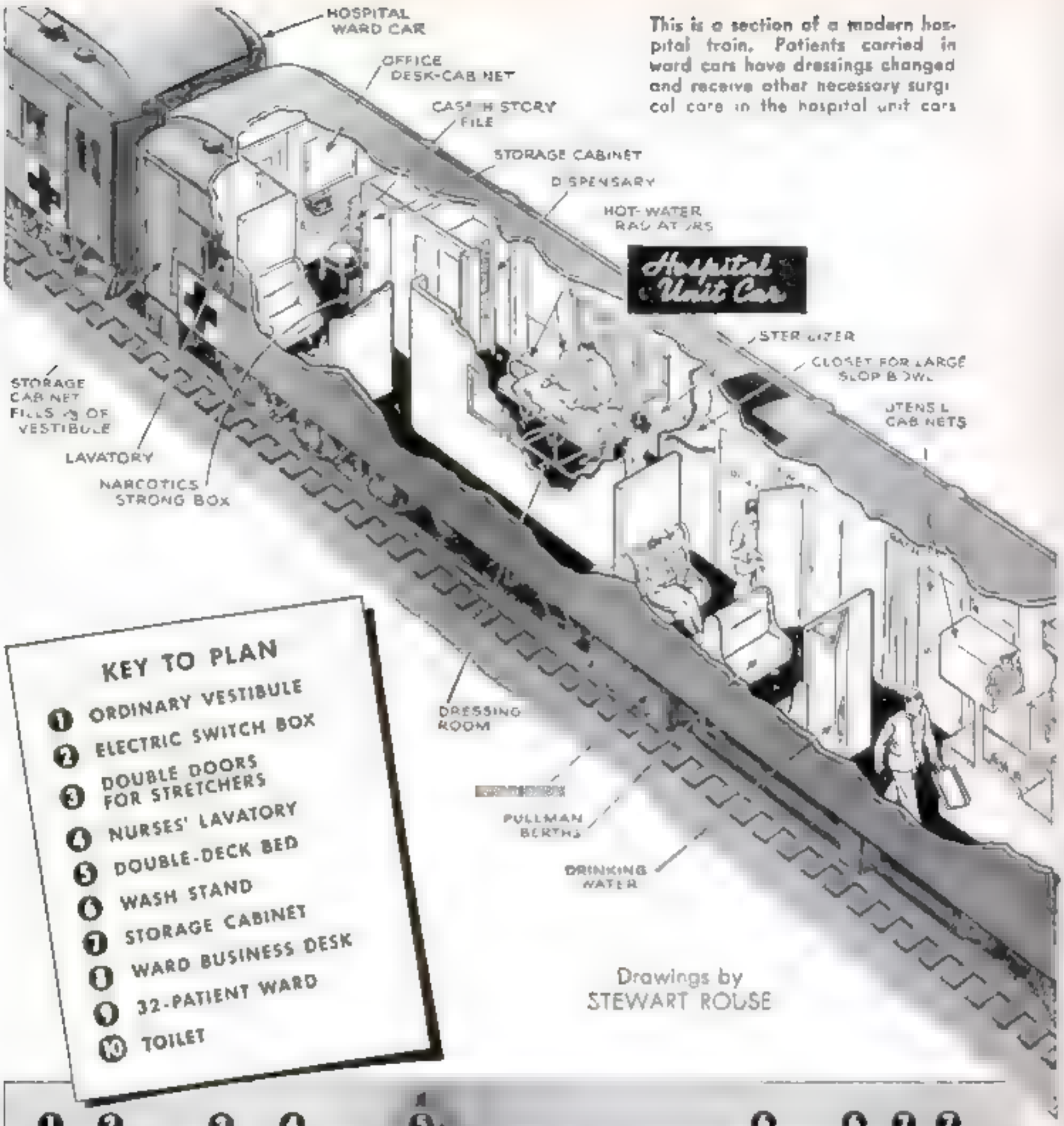
The illustration at left below is a schematic representation of our Army's current arrangements for handling the wounded. From right to left, the sketch shows the combat area between the battle front and the nearest railhead. Evacuation is carried out in stages or echelons. The zone between the battle line and the collecting station or assembly point, normally about $1\frac{1}{2}$ to two miles in depth, is called the first echelon. In this zone all service to the wounded is rendered by medical personnel attached to the

MEDICAL OFFICER carries a field pack, gas mask, first-aid packet, canteen, and musette bag. An important innovation in his equipment is the use of prepared units for administering morphine. These are much more easily used under fire than the hypodermic-syringe outfits formerly employed

MECHANIZED FIGHTING ADDS TO TRANSPORTATION PROBLEM



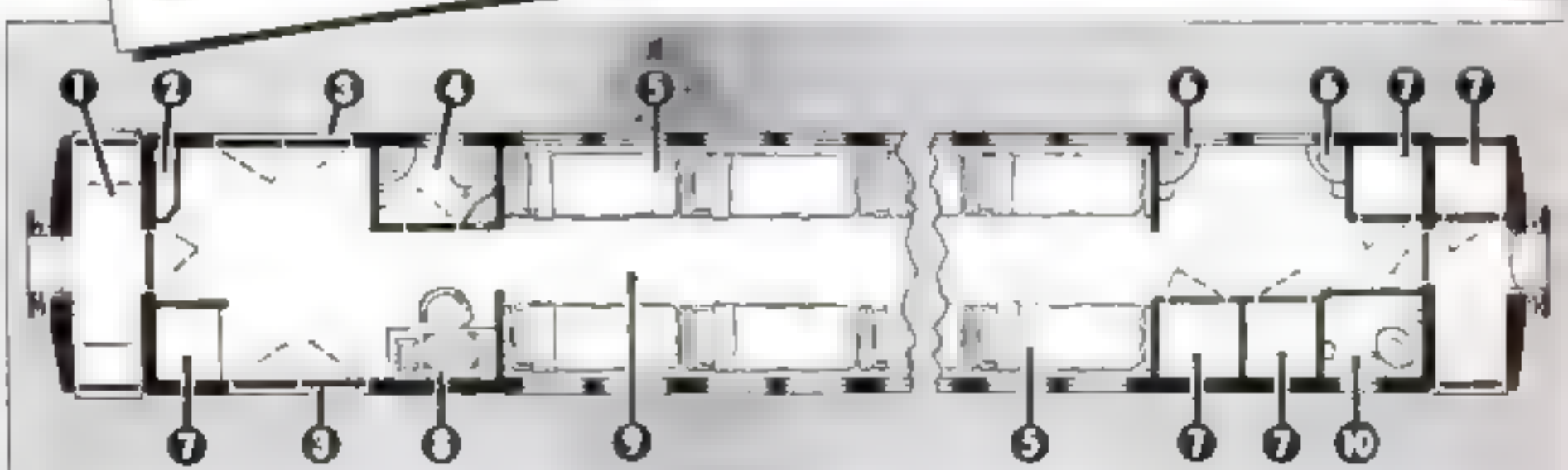
This is a section of a modern hospital train. Patients carried in ward cars have dressings changed and receive other necessary surgical care in the hospital unit cars



KEY TO PLAN

1. ORDINARY VESTIBULE
2. ELECTRIC SWITCH BOX
3. DOUBLE DOORS FOR STRETCHERS
4. NURSES' LAVATORY
5. DOUBLE-DECK BED
6. WASH STAND
7. STORAGE CABINET
8. WARD BUSINESS DESK
9. 32-PATIENT WARD
10. TOILET

Drawings by
STEWART ROUSE



PLAN OF HOSPITAL WARD CAR

line units. The second echelon begins at the collecting station and extends to the clearing station five to eight miles behind the line of departure. This is a divisional zone, in which service is rendered by the division medical units. Still farther back, in the third echelon, the medical units attached to an army, which consists of several corps and divisions, take over the casualties.

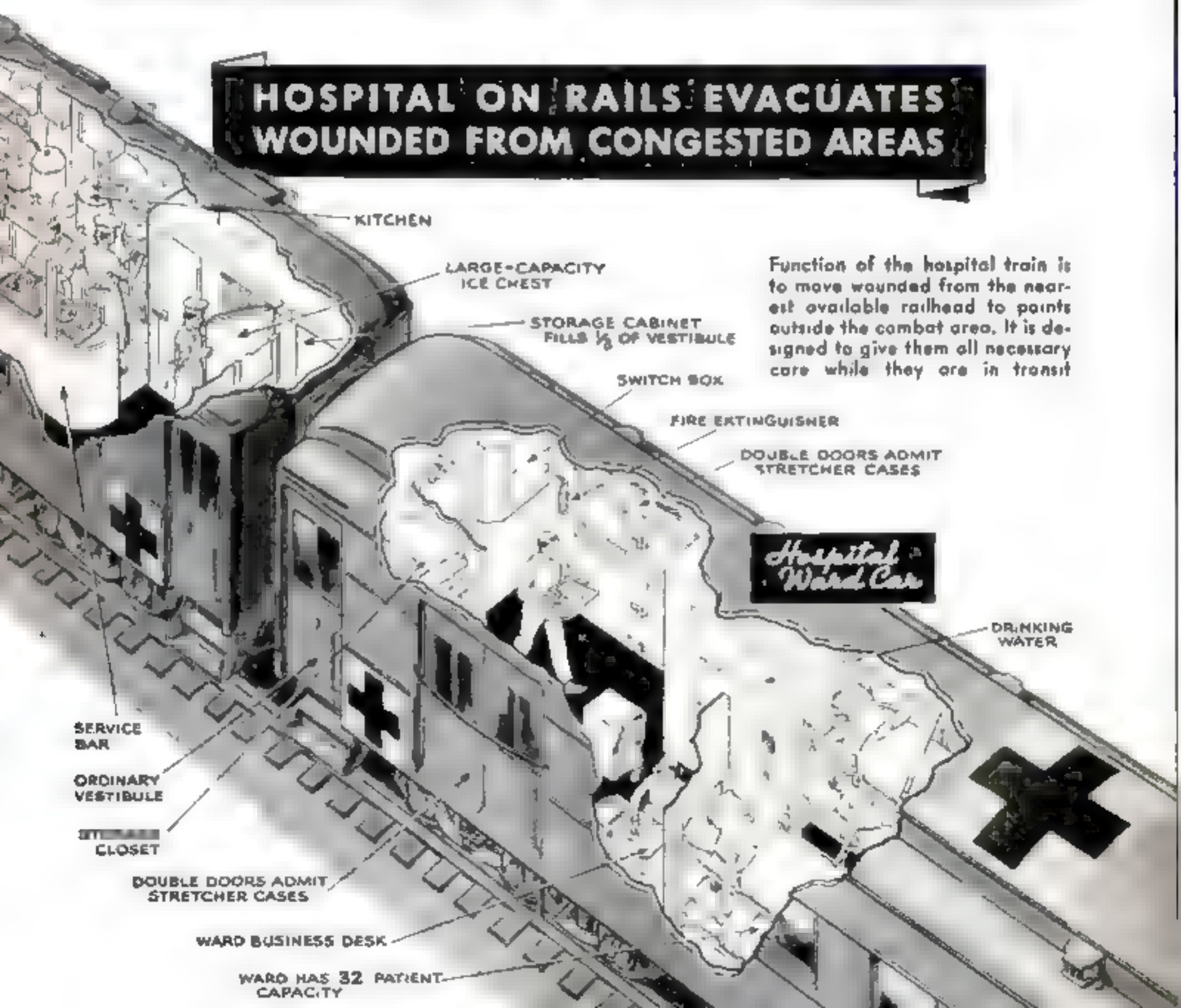
In the battle area itself, essential first aid is given to the wounded, under whatever cover can be found, by first-aid men attached to the companies in combat. The next step is to get the wounded back to battalion aid stations some 300 to 500 yards behind the front line. These field dressing stations usually afford shelter from rifle fire, but not from chance artillery hits. Every effort is made to locate them so that the wounded can be brought in by stretcher-bearers under some sort of cover, as behind a hill or ridge, and if at all possible be evacuated, when night falls, in vehicles rather than on foot. The normal complement of the aid station is two medical officers and seven enlisted men trained in handling injuries. Here efficient temporary dressing of wounds is possible and morphine is available.

If the battalion moves forward the station moves with it, the patients already deposited being left with medical attendance until they can be brought back, by ambulances or stretcher-bearers, to the collecting stations. Each of the collecting stations is fed by several battalion aid stations. Like the latter, the collecting stations move forward with the combat forces. The collecting stations are essentially intermediate medical bases where patients are examined, sorted, and prepared for evacuation to the clearing stations. Between the collecting and clearing stations an ambulance shuttle service is maintained. During the night the ambulances may be able to go all the way up to the battalion aid stations. When this is feasible the wounded are far better off, for it is in the first echelon that the worst bottlenecks occur.

The division clearing station is usually out of medium artillery range, and on a good route to both *(Continued on page 132)*

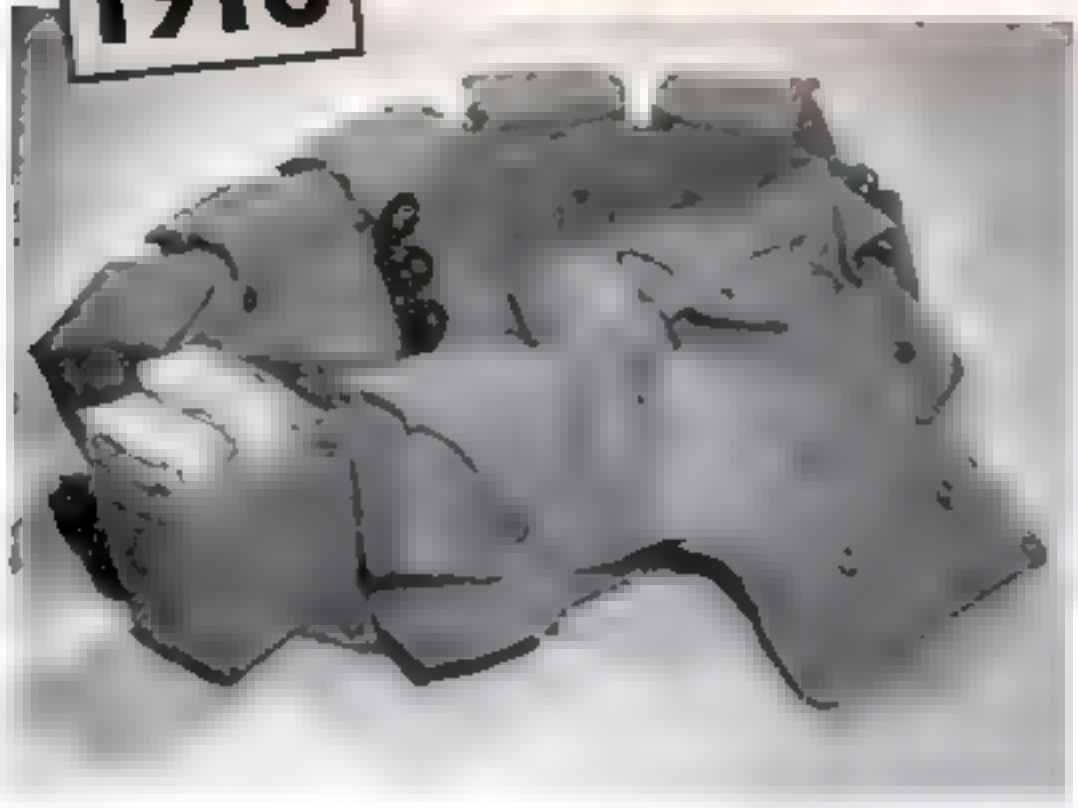
HOSPITAL ON RAILS EVACUATES WOUNDED FROM CONGESTED AREAS

Function of the hospital train is to move wounded from the nearest available railhead to points outside the combat area. It is designed to give them all necessary care while they are in transit

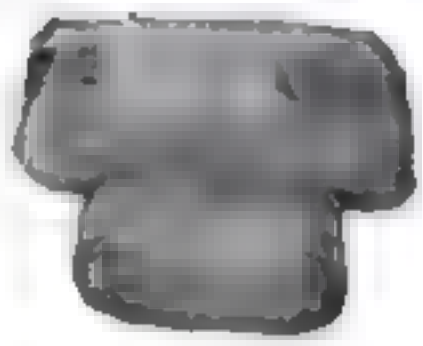


1918

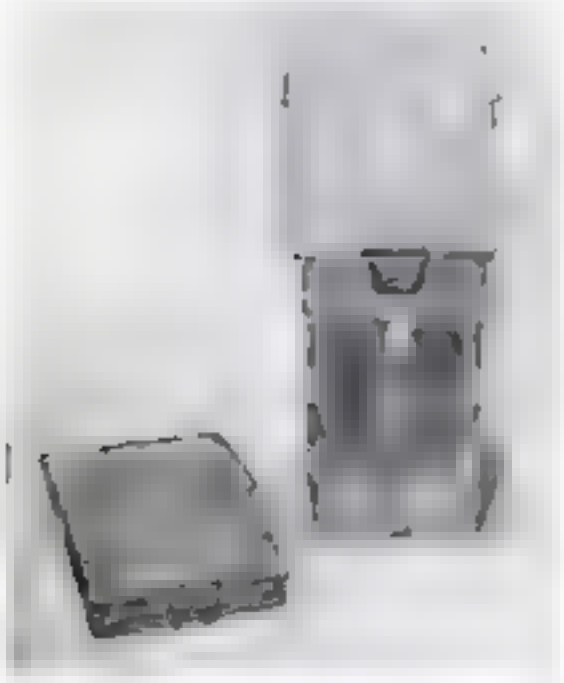
THIS IS THE MEDICAL MAN OF WORLD WAR I . . .



BELT held gauze bandages, individual dressing packets, iodine swabs, adhesive plasters, tourniquet aromatic spirits of ammonia, scissors, pencil, diagnosis tags



DRESSINGS for first-aid use were wrapped individually in sealed packets, often troublesome to open

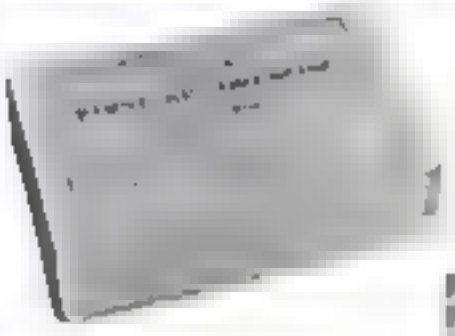


LAMP for applying dressings at night was the old folding Stonebridge candle lantern, shown at the left folded and open. Light from candle shone through its small isinglass window

MEDICAL MAN of first World War could not get at rear pockets of his belt easily under fire, or catch a nap between attacks with his belt on. Gas mask, not shown here, was also part of load

"M. D. CHESTS" held supplies for stations. Forward battalion aid station had two No. 1 chests with dressings and one No. 2 chest of surgical instruments and supplies. Chests weighed from 175 to 200 pounds each, and could be carried on a stretcher by four men

. . . AND THIS IS HIS COUNTERPART OF TODAY 1943



BELT pouch has a false bottom. Regularly worn as at the right, above, it can be extended by removing the lacing to make room for additional supplies, bandages

DRESSINGS now come in individual cartons like this, which keep them in better shape and handier for first aid

LAMP with neon tube and battery has been developed and may be made standard equipment for emergency operations as well as for dressings in the field

MEDICAL MAN, 1943 model. All his equipment is designed for efficiency and adaptability to conditions. Note adjustable-depth pouches. Additional supplies carried are governed by conditions

PACKS are now being tried out as substitutes for chests for forward aid stations. Two of these, weighing about 40 pounds each, would replace a chest. Slide fasteners give ready access to bandages and supplies, as seen at right. Modern packaging saves space

LEFT POUCH contains pencil, book of tags, eight small first-aid packets. The litter-carrying straps (not shown) also have a place

RIGHT POUCH holds ammonia flask and cup, iodine swabs, triangular and gauze bandages, adhesive plaster, safety pins, and scissors

Pouch at normal size (right) and extended. In regular use, false bottom folds compactly. If lacings are removed size of pouch is doubled

WATER may have to be carried to forward aid stations. This is an experimental pack with which a man can carry a five-gallon QM can

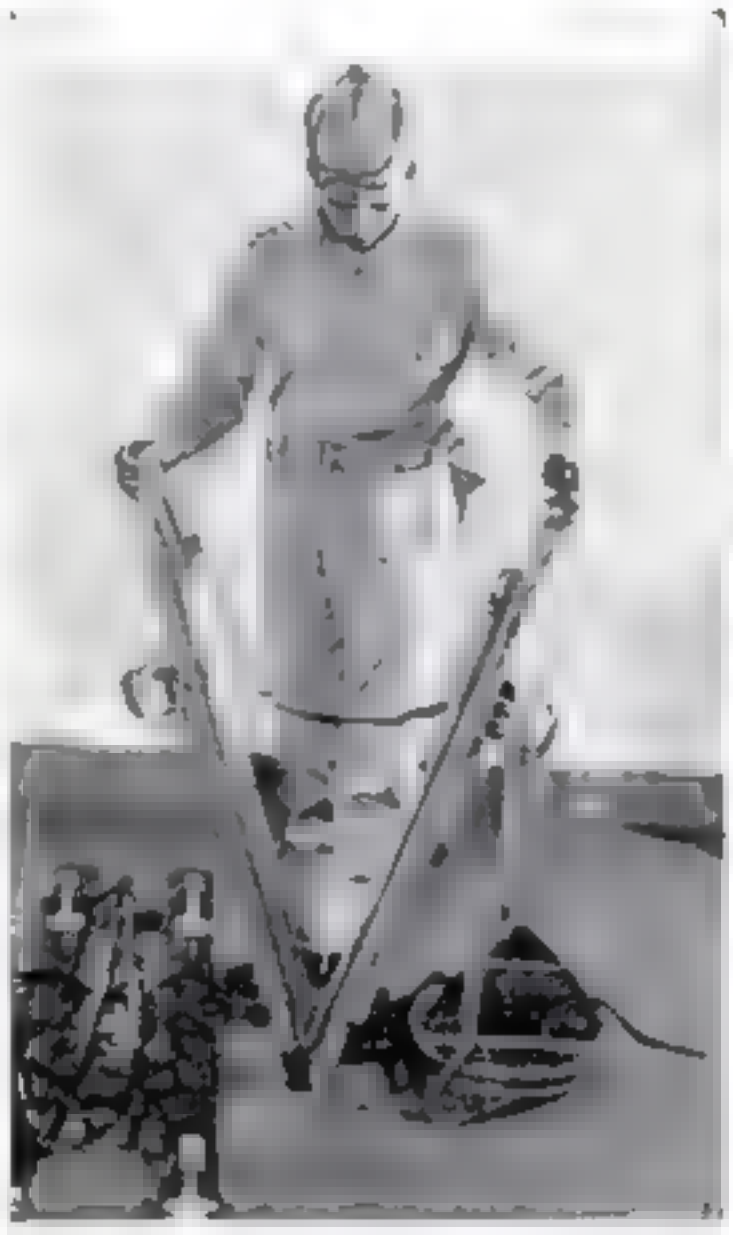
the front and the rear. Here a more careful sorting of casualties takes place. Some may be found fit for duty and returned to the front. Others, who require operative treatment, are taken care of by a mobile surgical unit attached to the clearing station. Thence the serious cases are sent back to the evacuation hospital, which normally is located at a railhead or airport where hospital trains or planes are available to take them out of the combat zone as soon as they are fit for the journey. Less serious injuries are treated at a convalescent hospital in the same neighborhood. After discharge these are sent to a replacement depot and returned to the front.

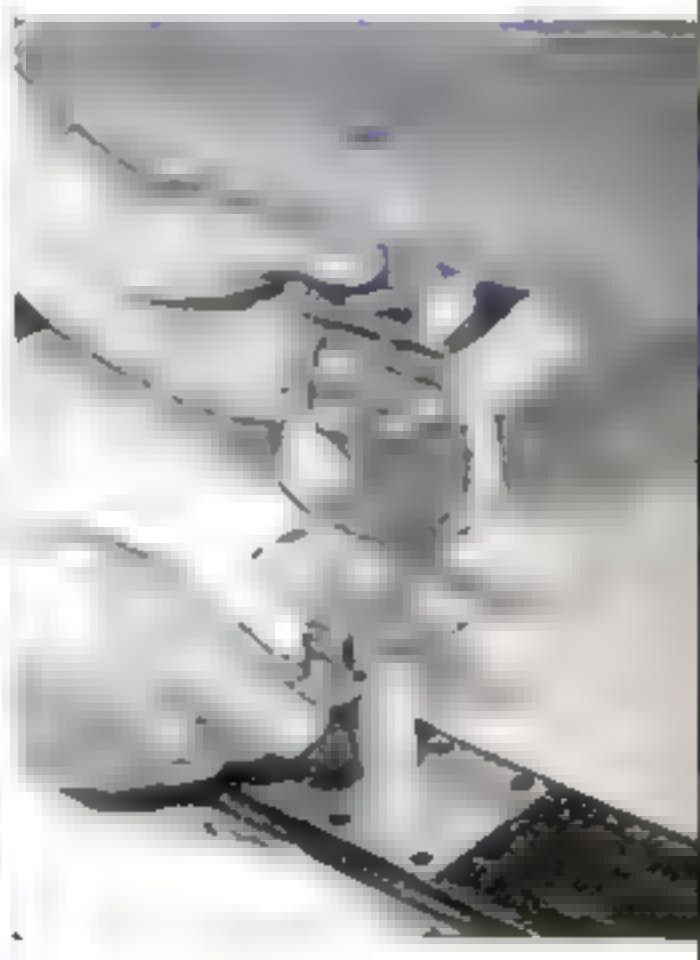
The foregoing will give the reader some idea of the transportation difficulties involved in giving first-aid and evacuation service to the wounded. Yet it presupposes a relatively slow-moving tactical situation in which the disabled man has to be carried only a few hundred yards on a stretcher before he is laid on a table before a medical officer. Suppose, however, that the injured soldier is in a tank operating with an armored division. There is no room for company aid men in tanks. Members of tank crews are trained to take care of their own emergency cases, using vehicular first-aid kits carried in the tanks. The company aid men follow the advance in motor vehicles and collect casualties along a central axis of evacuation. They then get their patients to the rear from prearranged rallying points. Half-track armored vehicles which have carried armored-division infantry behind the tanks are often used for this purpose. These half-tracks are equipped with litter braces so that they may be used as improvised ambulances.

Who are the men responsible for the health of the millions of Americans already in the Army and the millions who will soon join them? Where do they come from and how are they trained? Some civilians have an idea that most of the Medical Department's personnel consists of physicians. The fact is that out of a total strength of 125,000 before Pearl Harbor

(current figures are restricted), only 13,000, or a little more than 10 percent, were officers, and not all of these were physicians. In World War I the Medical Department numbered 400,000—an army within an army. There is nowhere near that number of licensed physicians in the United States. Obviously, while physicians provide the military and scientific leadership in the Medical Department, the bulk of the routine work must be done by officers other than Medical Corps physicians. This calls for a gigantic training program.

Today, the Medical Department is operating four medical replacement training centers and nine special-service schools. Men are assigned to the schools on the basis of civilian occupa- *(Continued on page 228)*





Collapsible litter (seen being unfolded at left) is clamped to fixtures on skis to form a light sled on which a wounded man can be dragged over snow

WITH SKI TROOPS the medical soldier carries a special arctic pack. Equipment, shown below, includes ski litter and poles, heating pad, and (left to right) shelter half, restraining strap, pack carrier, snowshoes, medical pouch, draft harness, blanket. In the photographs above, the soldier is not wearing the arctic uniform

Give your Cooling System a break

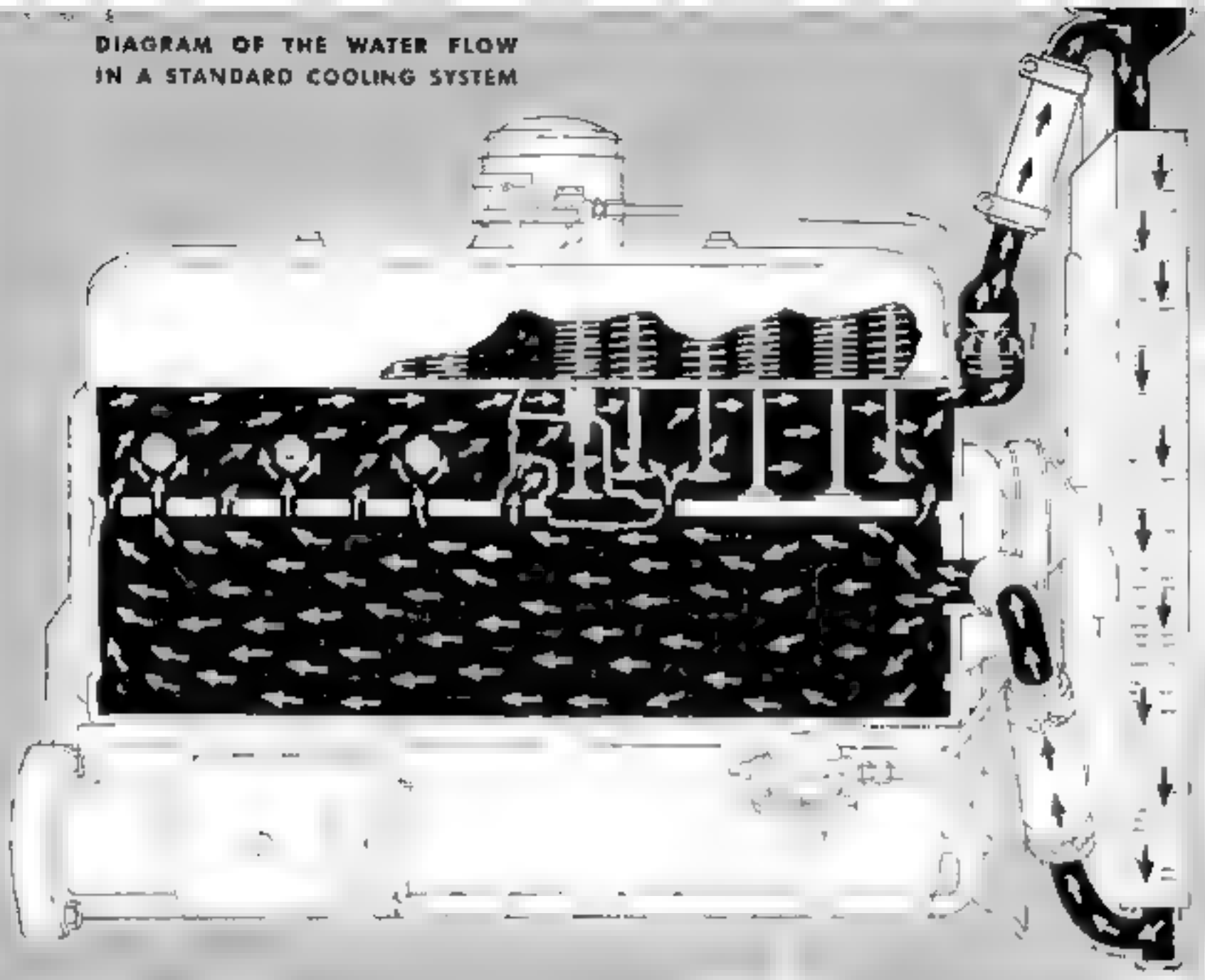


DIAGRAM OF THE WATER FLOW IN A STANDARD COOLING SYSTEM

As a Vital Part of the Car, It Deserves Good Care. Neglect It and It Will Burn Your Engine—and a Hole in Your Wallet

By RALPH ROGERS

OUTSIDE of keeping oil in the engine, and grease in the transmission and rear axle, the most important service consideration on an automobile is the care of the cooling system. An engine would not run very long without oil, for without the protective oil film to keep moving parts separated, the metal-to-metal contact would quickly develop high temperatures and the engine would "seize," resulting in an expensive repair job.

Similarly, if the cooling system is neglected, and the engine is operated continuously at excessively high temperatures, the internal parts are subjected to all sorts of abuse, due, chiefly, to lubricating-oil breakdown and the formation of varnish on pistons and valves. High temperatures cause rapid oxidation of lubricating oil, the products of which have no lubricating value and only gum up the works. Serious damage may be done to cylinder walls, pistons, rings, valves, bearings, and other parts.

It is well to remember that overheating is not always caused by defective operation of cooling-system units. Space does not permit a complete listing of these "foreign" causes, but among the most common are: late ignition timing; dragging brakes; slipping clutch; lack of lubrication; wheel bearings too tight; radiator clogged with insects; and excessive low-gear operation.

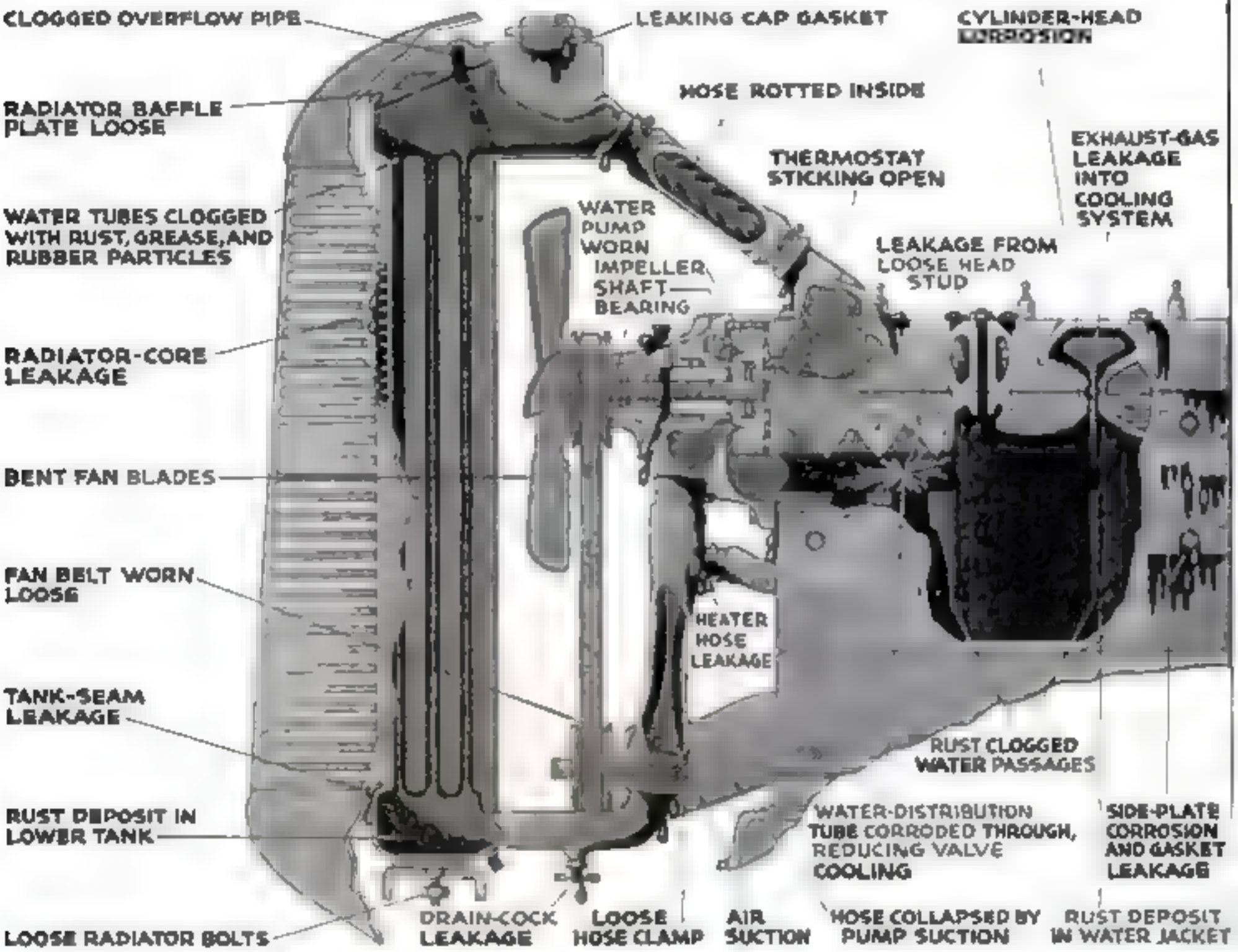
Overcooling is another factor to be considered. Too low temperature, besides being just as wasteful as excessively high temperature, may permit formation of corrosive acids which can cause serious damage to metal parts, especially bearings—which is always an expensive repair job. During warm weather, the steam in the exhaust gas which blows past the pistons is generally removed by heat and crankcase ventilation. In the winter, however, lower engine temperatures reduce the efficiency of crankcase ventilation, with the result that some of the steam condenses to form water which drops into the oil in the crankcase. This oil-and-water mixture forms a thick sludge which clogs filters, screens, and pipe lines, thereby restricting the flow of oil. Besides, in cold-operating engines, the exhaust gas dissolves in the water and forms corrosive acids which attack various parts of the engine, sometimes causing very serious damage. This

water-condensation condition is often aggravated in cold-operating engines by stop-and-go low-speed driving, defective thermostats, or operating with the thermostat removed. Corrosion of working parts of the engine may be indicated by a rusty oil-level dip stick.

During cold-weather operation, proper engine temperatures can best be maintained by replacing a low-opening thermostat with one of the high-temperature type having an open temperature range of from 160 to 180° F., or higher, depending upon the expected intensity of the cold weather in the region the car is being operated.

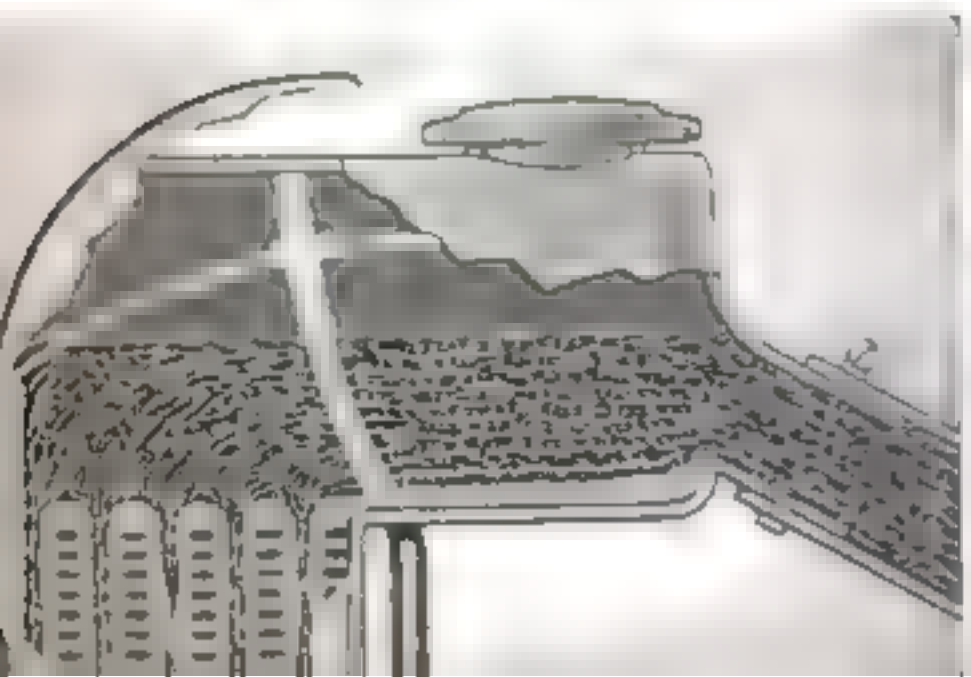
INSPECTION. To maintain the efficiency of the cooling system, a systematic inspection should be made at least twice a year,

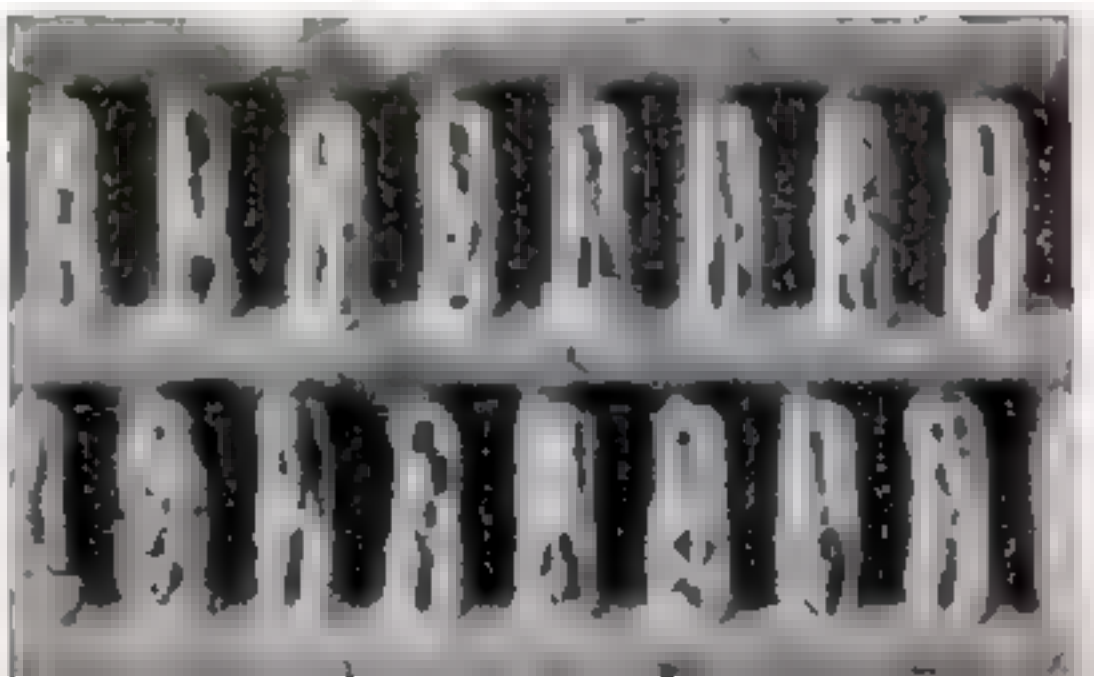
These Are the Danger Spots in Your Cooling System . . .



RUST PARTICLES in radiator tubes show rust has loosened in engine water jacket. Use of an antifreeze which loosens more corrosion only worsens condition

RUST-CLOGGED RADIATOR CORE, caused by bits of rust forming scale in water tubes, can be prevented by periodic cleaning and rustproofing





preferably in the spring and fall when antifreeze is removed and installed. At these periods, be sure to do the following: 1. Check condition of hose connections. Tighten clamps if necessary and replace cracked or swollen hose. 2. Check fan belt for proper tension. If belt is frayed, it should be replaced. 3. If car has a radiator-sealing-type cap, check its valve operation. 4. Inspect the water pump for leaks. A leaky water pump sucks in air, thereby increasing corrosion. 5. Check radiator core for leaks, and be sure the air passages in the core and grille are not clogged with insects or dirt. If necessary, the core should be blown out with an air hose, using low air pressure. 6. Check the operation of the thermostat. Thermostat failure is a common cause of

. . . and the Troubles That Can Seriously Injure Your Car

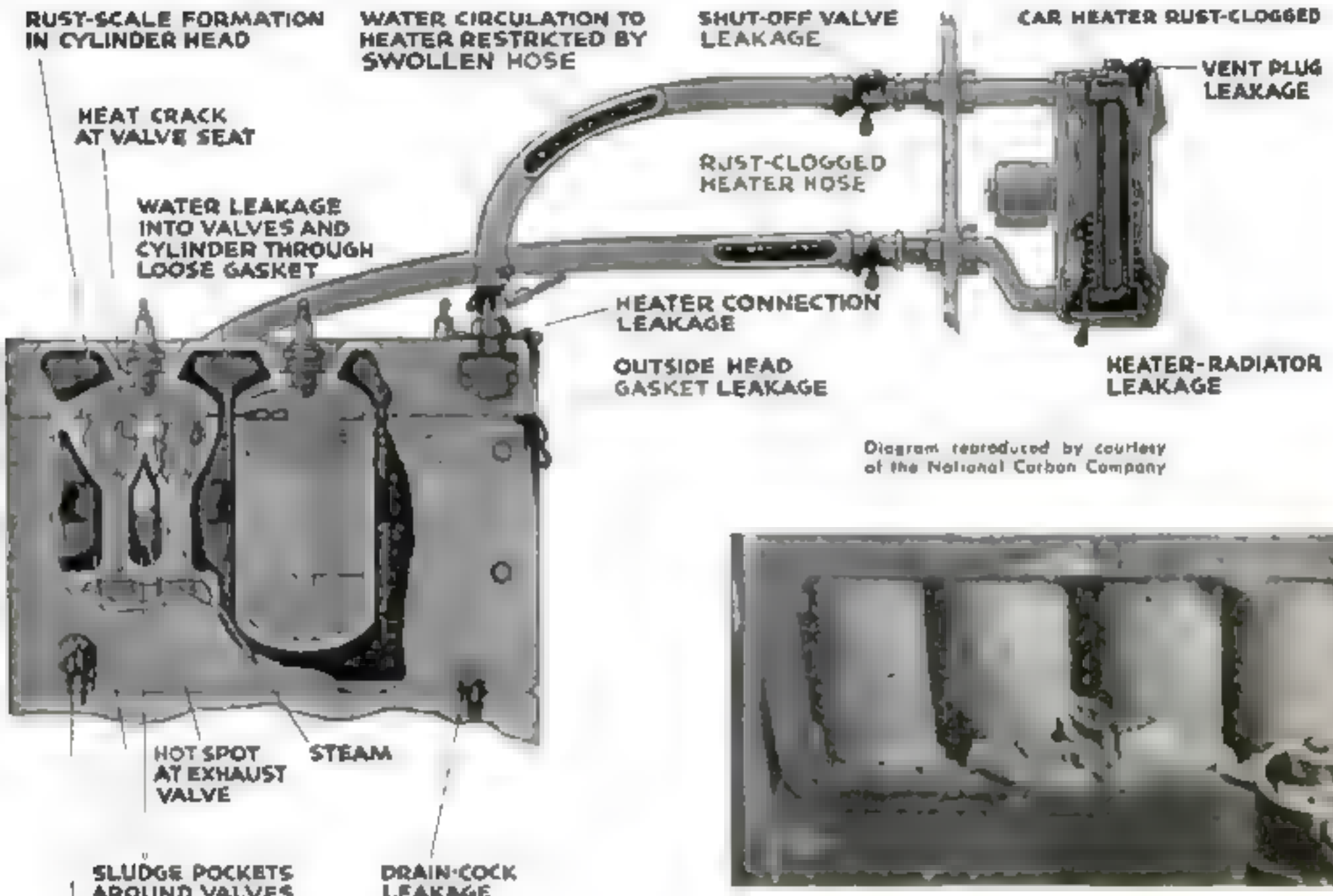
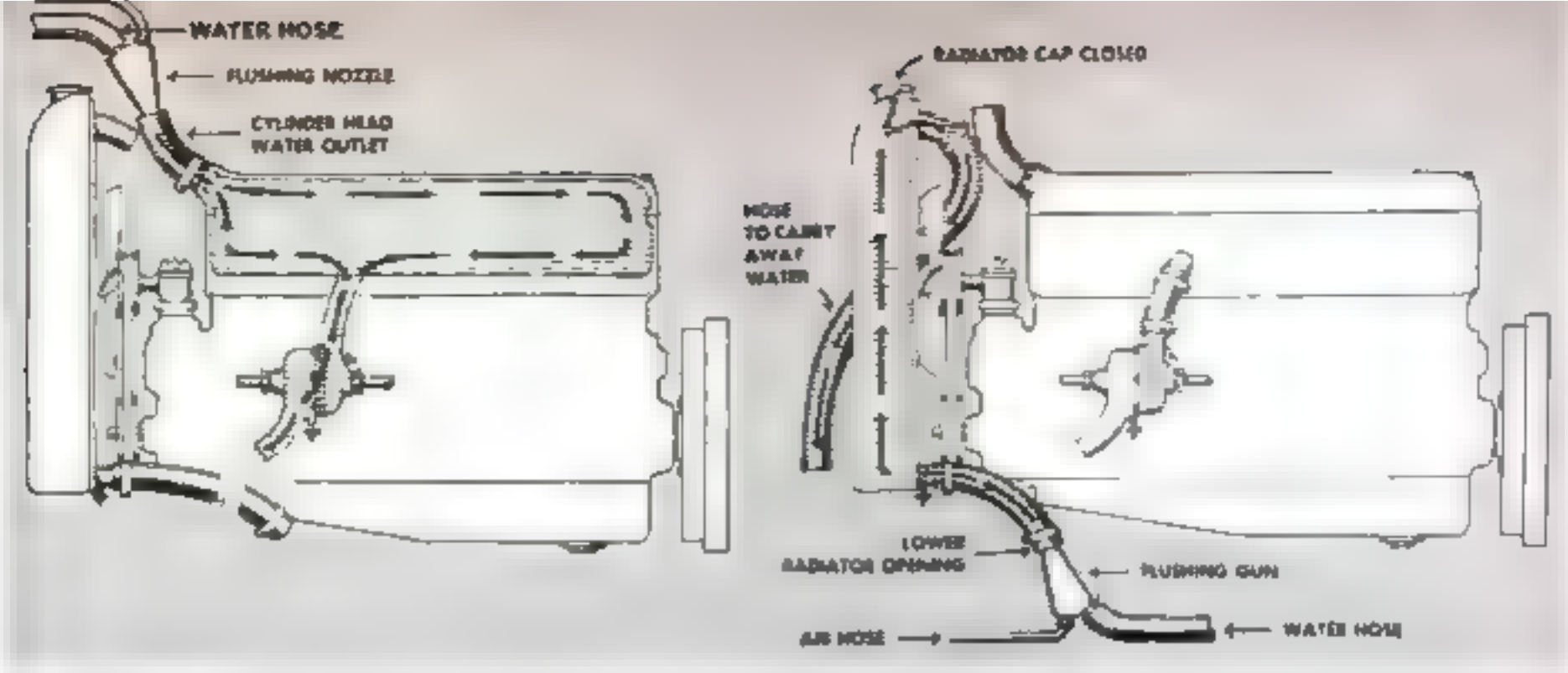


Diagram reproduced by courtesy of the National Carbon Company

WATER-JACKET PASSAGES can become so clogged with particles of corrosion that radiator cooling will be almost entirely nullified

ROTTED WATER HOSE may cause serious overheating by suddenly breaking off or by gradually shedding bits of rubber which clog radiator tubes

JAMMED PISTON RINGS and burnt valves are the eventual result of inefficient cooling—and the beginning of an expensive repair job



REVERSE FLUSHING METHOD consists of flushing the system in the opposite direction to the normal water flow. It is also a good idea to flush the radiator separately, as shown at above right, and to apply the air gradually, as a radiator clogged with dirt and scale will stand only a limited pressure

engines running either too hot or too cold.

THERMOSTATS. Thermostats are located in the cylinder-head water-outlet casting or in the upper radiator hose, and are used for the purpose of automatically controlling the engine-operating temperatures. When a cold engine is started, the thermostat valve is closed, preventing water in the radiator from entering the cylinder block and head. The water in the block and head is then warmed up, permitting the engine to reach its normal operating temperature quickly, and resulting in more efficient operation in respect to power and gasoline consumption. During the warm-up period, there is a loss of fuel due to the condensation produced by cold cylinder walls, with the result that gasoline drips into the crankcase, causing oil dilution and its resultant evils. The use of a thermostat cuts down the warm-up period so that the engine quickly attains a temperature at which the fuel condensation is at a minimum.

To test the operation of a thermostat, suspend it by its frame in a vessel of water which is heated to about 10 degrees above the temperature at which the unit is designed to start opening. When taking temperature readings, stir up the water to be sure it will be of uniform heat, especially if the vessel is a large one. Then if the valve fails to open, replace the unit rather than attempt to make a repair.

CLEANING COOLING SYSTEM. If the water is not treated with a corrosion preventive, scale and rust will eventually clog the passages in the radiator and water jackets. Cleaning solutions are available which successfully purge the cooling system of all rust, sludge, and grease, provided the manufacturer's instructions are carefully followed. However, if the radiator is clogged with an insoluble salt scale, which is a product of the water in some parts of the country, it should be removed by a reliable radiator-service station familiar with local conditions, and equipped to apply proper treatment.

To clean the system, drain the cooling liquid, close all drain cocks and fill the system with the cleaning solution according to the manufacturer's directions. Then with the radiator cap on tight, run the engine hot (not boiling) at medium speed for about 20 minutes, after which, drain off the solution and pressure-flush with clean water.

If the reverse flushing method is used—that is, flushing the system in the opposite direction to normal water flow—flush the radiator separately from the block as shown in the illustrations. However, apply the air gradually, as a clogged radiator will stand only a limited pressure.

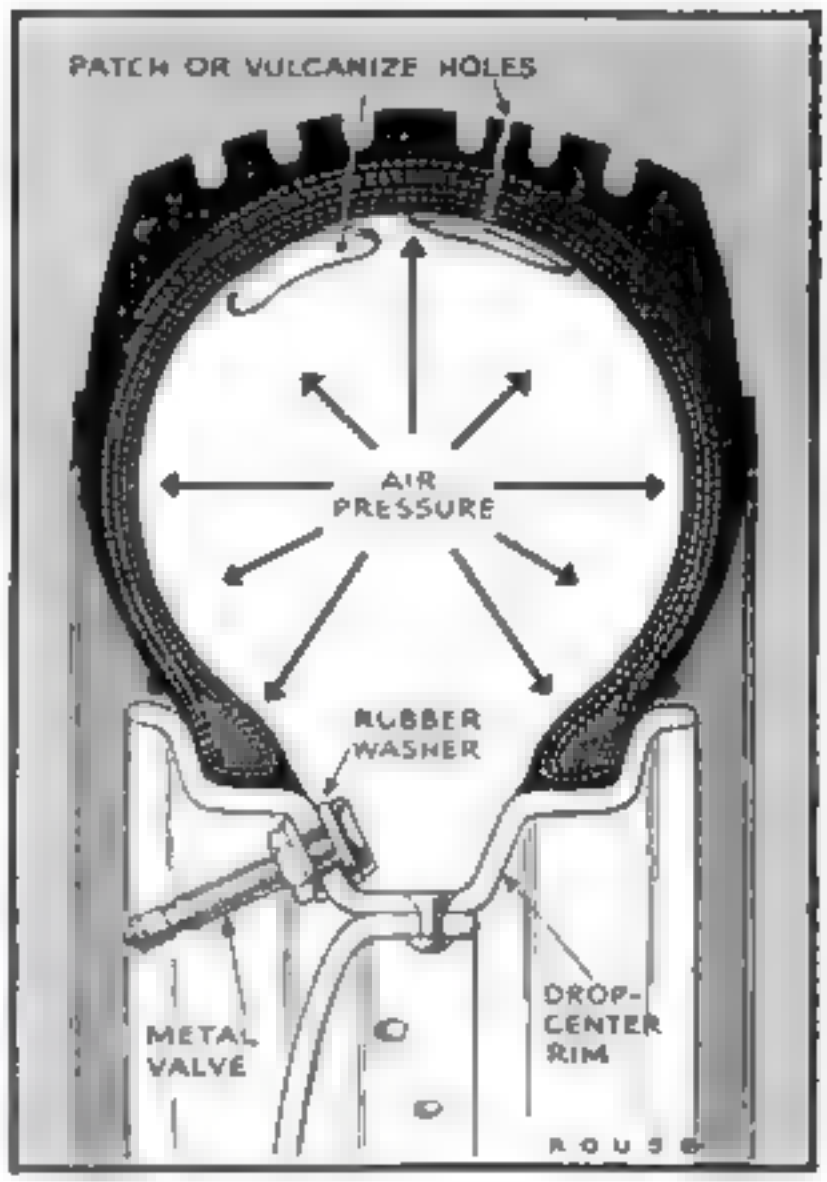
After cleaning the system, be sure to check the thermostat, clean the overflow pipe, and blow all dirt and insects from the radiator air passages and radiator grille.

RUST PREVENTIVES. Treatment of the cooling system for the prevention of scale and rust is a must item if the efficiency of the engine is to be maintained. This process consists of introducing certain substances called inhibitors. Inhibitors are not cleaners, and will not remove rust or scale already formed. Therefore, they should be used continuously, and preferably immediately after the cooling system has been thoroughly cleaned or when the vehicle is new.

Rust preventive should not be used with an antifreeze preparation already containing an inhibitor, as an excessive amount may be harmful to various parts of the cooling system.

TUBELESS TIRES . . .

Oklahoma Motorists Ride on Inflated Casings



IF YOU have four tires but are short an inner tube, you can drive without it, says J. B. McGay, a Tulsa, Okla., manufacturer, who has worked out a method of mounting ordinary casings without tubes so that they can be inflated and run at normal speeds. About 700 tires so mounted are in operation in Tulsa alone, some of them having run as much as 12,000 miles in three months. The casings, it is reported, lose no more air than do tires with tubes.

Radical as this idea may appear to motorists who have always taken inner tubes for granted, there have been hints that tubeless tires are coming after the war. In fact, one of the leading rubber companies has already announced the invention of a new type of truck tire that requires no tube and effects a rubber saving of from 7 to 17 percent, although the details are being kept secret in the interest of national defense.

The technique of mounting ordinary tires without tubes is surprisingly simple. An old-style metal valve stem is fitted, with a suitable gasket, into the existing valve hole in the metal rim. Then any puncture holes and breaks in the old casing are cold-patched or vulcanized. Both beads are cleaned and rough places sanded smooth. Any corrugations on the beads must be ground off. The outside tire bead is pressed onto its shoulder with the rim or wheel so supported that the casing hangs free.

The valve core is removed so that air can be introduced quickly, and while the hose is applied, the casing is beaten lightly with a mallet to cause the lower bead to make contact with the rim and form the seal. When it snaps into place, the valve core is inserted and the tire brought to normal pressure. It is then submerged in water to check against leaks. Most satisfactory results are obtained by putting about a quart of tire-sealing fluid into the casing before it is mounted.

Mr. McGay suggests that, if all car owners mounted their tires this way and turned in their tubes, a stock pile of 250,000 tons of excellent rubber would be available for other uses. The Army, by mounting tires in this way, he estimates, could save 100,000 tons of crude rubber now allocated for tubes. According to Mr. McGay, the plan would leave the nation with a surplus of 139,000 tons above military requirements, with which to recap essential civilian tires.

Auto Ideas

WAR TIRES made almost exclusively from reclaimed rubber by Goodyear are identified by a "war tire" seal. Shown at left being prepared for curing, and at right being taken from the vulcanizing mold, these new tires should yield as much as 10,000 miles if used carefully.

MUFFLER CLAMPS of the full-circle type, which consist of an extra-heavy stamping, a U bolt, two nuts, and washers, have been designed to connect muffler and pipes snugly when the pipes are out of round. Said to reduce leaks and installation time, these new clamps are available in sizes for every type of private car, as well as for the new Reo, White, and Willys-Overland Army trucks.

A SPEED-LIMITATION HORN for gas-and-rubber-saving drivers, toots its warning when the speedometer needle makes contact with a button set at the 35-mile mark on the dial. Contact opens a valve in the exhaust, which in turn blows the horn.

A LUBRICANT containing 22 percent by weight of colloidal natural (not synthetic) graphite dispersed in complete suspension in water, has been developed for all types of water pumps and cooling systems. Containing no oil, alkali, or chemical, the lubricant does not affect rubber or antifreeze, and is said to coat parts with a surface which repels rust.

A HUB-CAP DOLLY and a plastic hammer are the answer to the problem of straightening out dented hub caps. Six inches in diameter and weighing seven pounds, the iron dolly has two concave surfaces—a deep one for the smaller caps and a shallow one on the other side for the larger.

"Looks as if your pupils have been playing tricks again—the way they did when they put sugar in your oil. Ever see this ball before, professor?"

GUS gives the professor a lesson

When a Plug Went Bad in Scruggs' Car, the Sparks Flew. But the Mechanic of the Model Garage Fixed Things Up

By MARTIN BUNN

FOR quite a few years, Professor Hiram Scruggs, the principal of our high school, has had—and richly deserved—the reputation of being the biggest grouch in town. When he drove into the Model Garage the other afternoon, Gus Wilson's ears told him that the professor's engine was missing.

Scruggs got out and scowled at Gus. "Another example of the widespread inefficiency which is the curse of this country!" he sounded off. "In spite of the fact that I had my carburetor repaired only a week ago, my motor is missing badly."

Gus grinned at him. "Just what seems to be the matter with your antique chariot?"

"I've already told you what the trouble is," Scruggs said impatiently. "I said that I had my carburetor repaired—"

"Why?" Gus asked.

"Because my motor wouldn't idle. Every time I stopped for a red light the motor raced. I was at my country home at Coldspring Lake, and the garageman up there said that the carburetor must be causing the trouble. He removed it from the car and examined it carefully, but all he could find wrong was that there was a small brass screw missing from the—the butterfly valve, I think he called it. He replaced the missing screw, and the motor ran beautifully until this morning, when it started to miss."

Gus got a screwdriver, held its metal shaft to the top of the No. 1 spark plug terminal and its point against the engine. No. 1 cylinder stopped firing, and the engine labored. He checked two more cylinders with the same results. But when he did the same thing with No. 4 there was no change. He unscrewed it from the engine head.

"Here's the trouble," he told Scruggs. "Number four spark plug isn't firing."

Then he saw something that made him whistle. Wedged in between the center electrode and the base of the plug was a little brass ball. "Now where the devil did *that* come from?" he asked himself. He held the plug out for Scruggs to see. "Looks as if some of your affectionate pupils have been playing tricks on you again—the way they did that time they put the sugar in your oil," he told him. "Ever see that little brass ball before, professor?"

"Certainly not!" Scruggs snarled. "And if I find that any of those young hoodlums have been—"

"Wait a minute—wait a minute," Gus cautioned. "Remember that missing screw, professor?"

"Of course I remember it," Scruggs said. "But what in the world has it to do with this brass ball?"

"It's got a lot to do with it," Gus said. "Use those little gray cells of yours, professor—switch on that high-voltage brain power of yours. What? You still don't get it? Why, this little brass ball is the missing butterfly-valve screw. After it came loose it got into the cylinder, and then it was battered against the cylinder head by the piston until it got hammered into its present shape. After that it got jammed into the base of the spark plug, and caused a short circuit which kept your No. 4 cylinder from firing." Gus saw a skeptical look on the professor's face. "You don't believe it, hey? All right—I'll prove it to you."

He went into the stockroom, and came out a half minute later with a new spark plug which he screwed into the engine head. "Step on her," he directed. Scruggs did as he was told. The engine started easily, and ran as smoothly as could be expected of a piece of machinery of its advanced age, which never had been given intelligent care.

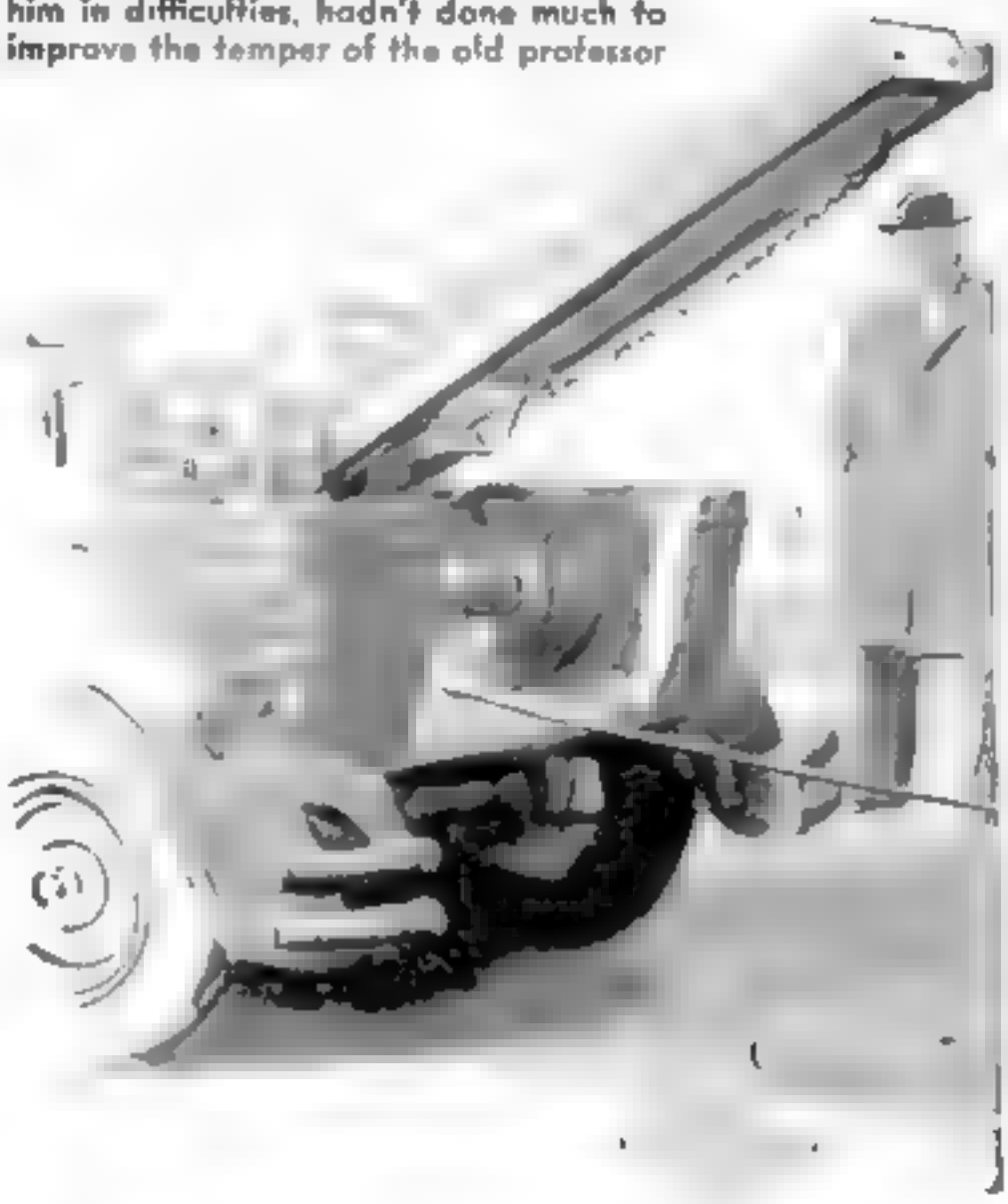
Professor Scruggs grunted, snarled over the price of the new plug, and at last got into his car and drove away.

Gus was finishing a job later that afternoon when he heard the office telephone jingling. A moment later his partner, Joe Clark, called out, "It's for you, Gus." When he walked into the office he found Joe grinning and holding his hand over the transmitter. "It's Professor Scrugga," he said, "and he's so darned mad he's sputtering."

Gus picked up the 'phone and said "hello." Five minutes later he hung up. "Apparently someone has put an infernal machine in the professor's car," he informed Joe. "Well, he had it coming to him, but I guess he's really in some sort of jam. Hey, Wally, take the wrecker and tow Professor Scruggs's car in. He's out past the old Craig place."

Wally, who holds the principal in the same low esteem as do most of his former pupils, departed with a broad grin on his grease-smeared face. The grin was even broader when he returned about a half hour later hauling the Scruggs sedan with its owner seated grimly behind the wheel.

His ride behind the wrecker, observed by fellow citizens who weren't sorry to see him in difficulties, hadn't done much to improve the temper of the old professor



The ride behind the wrecker, observed by numerous fellow citizens who obviously hadn't been sorry to see him in difficulties, hadn't done anything to cool Scruggs's temper. "This is an outrage!" he roared at Gus. "Either sheer, downright incompetence on your part, or plain dishonesty. How dare you send me out on the road in a car in that condition? I might have been killed!"

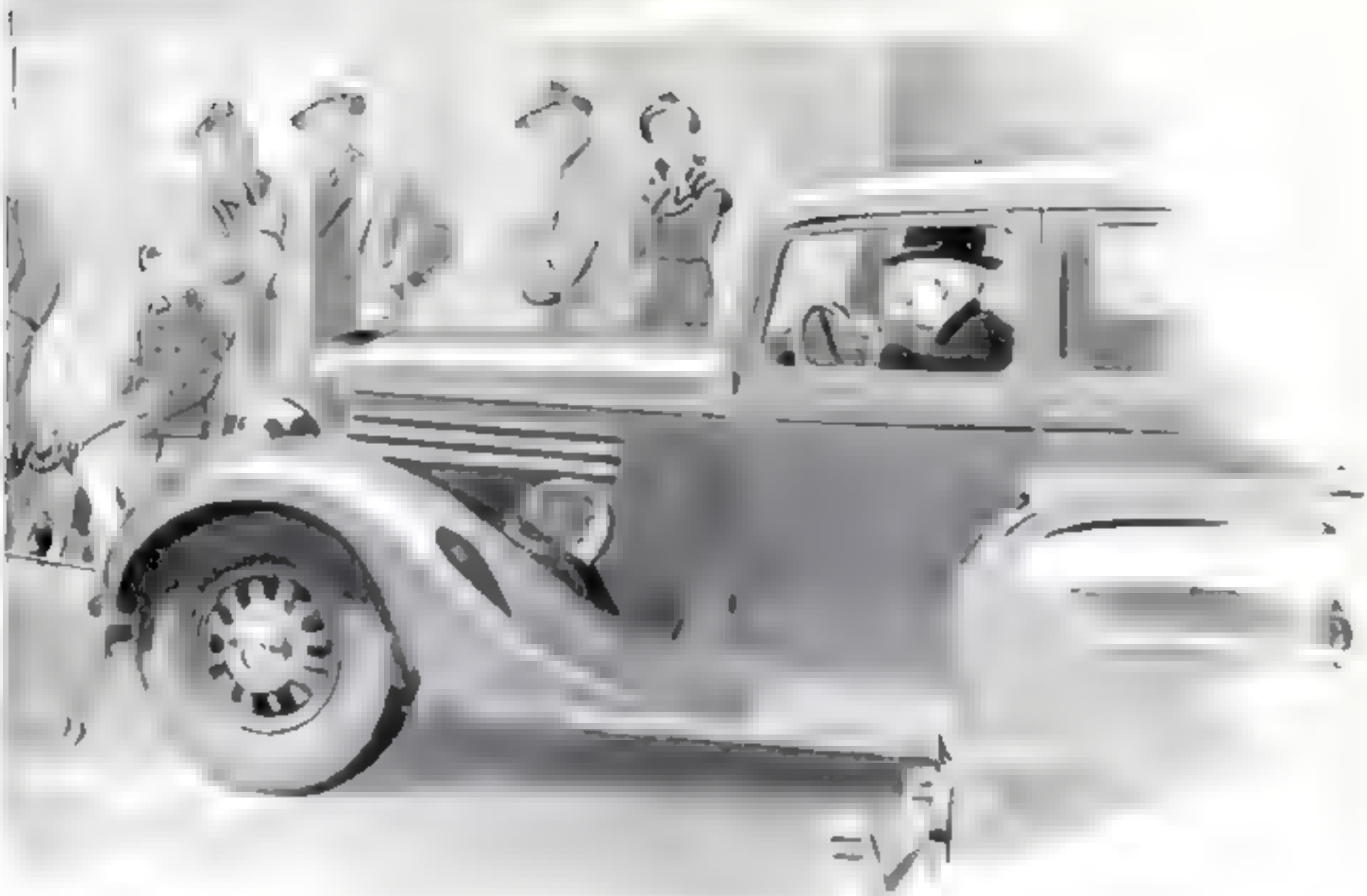
"Well, you weren't," Gus told him calmly. "But just what happened, anyhow?"

There wasn't much to the story. The professor had started out for his cottage at Coldspring Lake. Five miles out of town, while he was doing about 40, his engine had started to miss badly. Then he had been startled by a loud bang. He had got out of the car and, happening to look back, had seen a spark plug lying in the road. Picking it up, he had burned his fingers on it. Then he had raised the car's hood, and found a spark plug missing.

"And please understand that I haven't the slightest intention of paying a single red cent for this!" he shouted, getting mad all over again. "A disgrace-

GUS SAYS:

Wouldn't be much need to worry 'bout gas if folks would drive at 30; not race or idle a motor unnecessarily; keep parts well oiled, thermostat at the proper setting, and tires five pounds above specified pressures. Easy to do—and it pays dividends.



ful way to do work! You install a new spark plug, charge me a high price for it, and then within a few miles it blows out of my motor and endangers my life!"

Gus looked the plug over carefully, and then thoughtfully ran his thumbnail along its threading. Then he raised the hood and examined the engine. And then he laughed.

"This isn't the plug I put in," he told Scruggs. "I knew that as soon as I looked at it. This plug has been used for a long time. See how its electrodes are burned? It's out of your No. 6 cylinder. I put the new one in No. 4. See this cement on its threads? That's the tip-off. I can tell you just what has happened. Someone working on your engine—it might have been the garageman who fixed your carburetor, or it might have been someone before him—stripped the threads in the aluminum cylinder head when he was replacing the No. 6 spark plug. Trying to cover up, he cemented the plug in with iron cement, or something of the sort."

Professor Scruggs expressed his opinion of the entire automotive-repair clan luridly and at full length. Then he told Gus to fix his car up immediately. He was in a hurry.

Gus shook his head. "Sorry, professor," he said, "but I can't do a quick job on it. There are two ways of doing it. One is to rebore the cylinder head for a larger plug. The other is to install a new cylinder head. The first way is a lot cheaper, but a larger plug would destroy the heat-range balance. Using your original-size plug with an adapter is a special machine operation and we would have to have the adapter made. The only real answer is a new cylinder head because by the time I had the adapter made, the expense involved could be used to much better advantage toward buying a new head. Besides, your cylinder head is probably badly corroded by this time. If you want one installed, I'll be glad to do it for you, but it will take a day or so to get it from the city."

Scruggs ranted some more, but at length told Gus to install the new cylinder head. Then he started for the railroad station on foot and in a vile humor.

Gus shrugged his wide shoulders. Then he wrote out an order for the engine head and took it in to Joe Clark. Joe read it, and whistled. "A bad break for the professor," he said. "Well, if anybody has to have bad luck, it might as well be old Scruggs!"

EXPLORE YOUR HOME FOR

Pictures in Patten

By A. L. (WHITEY) SCHAFER

Portrait Photographer, Paramount Studios

"Whitey" Schafer is a pioneer among Hollywood's still photographers. Starting 22 years ago as a laboratory worker at Paramount, he was for ten years in charge of portrait, publicity, advertising and production still photography for Columbia Pictures. Now he is back at Paramount, in charge of all still photography and directing the work of the same laboratory where he started as a boy. He specializes in "pattern pictures" such as the accompanying ones of Ann Rooney and Lynda Gray.

THE man behind the lens, whether he be a professional or an amateur, sees life in terms of pictures. Since many of us are going to spend more time at home from now on, more of our pictures will have home settings. Why not make the best of the situation by getting interesting home patterns into your photographs? If you follow the suggestions I've found valuable in my studio work, you can build a collection of pictures that will not only portray your family and friends more interestingly, but will, in their settings, afford intimate glimpses of your home as well.

Any background other than a blank wall resolves itself into a pattern of lines or masses. Where in the home will you find interesting patterns? In the woodwork of a door, and its framework; in the brick sidewalk and the flagstones of your patio; in floor coverings, particularly rugs with strong markings; in chairs and lamp standards and iron grill work; in the grape arbor, a shade tree, the picket fence.

Two simple rules will serve as your guide:

1. Look for interesting line.

2. Do not shoot into "open" background, such as a plain wall.

Both rhythm and contradiction will provide interest. For example, lower the camera and you elongate a full-length figure. Have your subject lean away from the perpendicular when the design is rectangular to break up parallel lines, and so get a contradictory line between the center of attraction and the background. These points are well illustrated in the accompanying pictures.

There is one important exception to the second rule. You may safely photograph a girl in a pretty costume against a plain wall, for here interest centers in the girl and her garb. In general, though, it is the background that makes your pictures.

Any feminine wardrobe will include more than one costume with interesting pattern —a peasant dress, for example. Have your subject stand against the wall, hold or pin the dress up by the hem so as to frame her head and shoulders like a fan, turn one shoulder toward the camera, and you'll get a picture to be cherished. Unless you have a portrait attachment, you must be content with a waist figure. In enlarging, though, bleed the dress off the edges of the print, thus creating a feeling of endless design.

Snap a pretty girl in a gaily patterned skirt, and you'll wonder what flower garden she grew in! Here Lynda Gray's gown is held up against a wall to form a lovely background. Enlarged, the edges may be bled off to suggest infinity

Home wasn't like this until Ann Rooney was pictured against a wooden screen! Note how camera is tilted to get a contrast in lines, while a heavy shadow brings them out in relief. Have your subject look away from the lens

Pretty as a picture, Claudette Colbert looks demurely down from staircase at left. A curving banister breaks the severity of vertical lines without resort to ' angles ' or photographic tricks, and frames the white railing with striking effect. At right, a crisscross of sharply defined contours gives life and substance to this action photo. You can almost hear Richard Arlen announcing, ' First call for barbecues!"

How should you shoot for close-ups, medium figures or long shots? Does a door call for a medium figure and the mantel a full figure? Which odd corner holds promise of a beautiful composition?

Suppose we examine some concrete cases. The ideas they suggest undoubtedly will point the way to parallel possibilities in your own home.

Consider the front door, or perhaps the dining-room door. It may be paneled, or perfectly plain with handsomely grained wood. You'll agree, I am sure, that the form and pattern of the door are interesting; they're doubly so when sister or mother consents to pose. Again let us ask your subject to stand with one shoulder turned toward the camera. (If she stands straight on, her head will appear disproportionately small.) Place the camera at shoulder level—certainly no lower than the bust line.

"Four walls do not a prison make," but four sides of the door casing certainly will imprison your subject. So, either on the negative or when enlarging, crop so that the casing does not frame the picture. Let the panel bleed off the edges.

That's not an inflexible rule, of course. Some doors have interesting moldings or casings. When including this framework, to avoid the feeling of imprisonment, tip the camera opposite to the line of your subject's figure. If she leans to the right, tilt the camera to the left. By this means, the normally horizontal and perpendicular lines of the doorway will both frame the center of interest at an interesting angle and enhance the line of the figure.

Have you ever thought of a wall, a simple, unadorned expanse of plaster, as part of your home worth photographing? It can be, if you add interesting shadows. Some of the most effective portraits I have taken are medium shots photographed against such a background. Place your subject directly against the wall, turn one shoulder toward the camera and arrange a single key light high enough to cast a butterfly shadow under the nose so long as almost to reach the lip. No matter which way he or she faces, to avoid the illusion of a crooked nose the light must be cast to run the shadow directly down, and not even a trifle sideways. The single-source light will cast shadows along the wall, bringing out the relief that makes the picture. No back light is needed here.

Rugs, particularly those bearing a single predominant figure against an open or lightly figured field, offer interesting opportunities. They may be hung against a wall or left on the floor. In the first case, be sure to place the figure high enough so it doesn't conflict with the head of your subject. It's

a good plan to make this a medium shot, placing the subject in one lower corner, with the figure running out of the opposite upper corner. If you wish to avoid an unsightly shadow and focus attention upon the subject, place her about three feet in front of the rug. Thus, the background will be slightly out of focus.

A slightly different procedure applies when the rug is left on the floor. Now you'll shoot down from an elevation of about 5, tilting the camera so that the figure comes diagonally across the plate. Make sure your subject's head is closer to the camera than her feet.

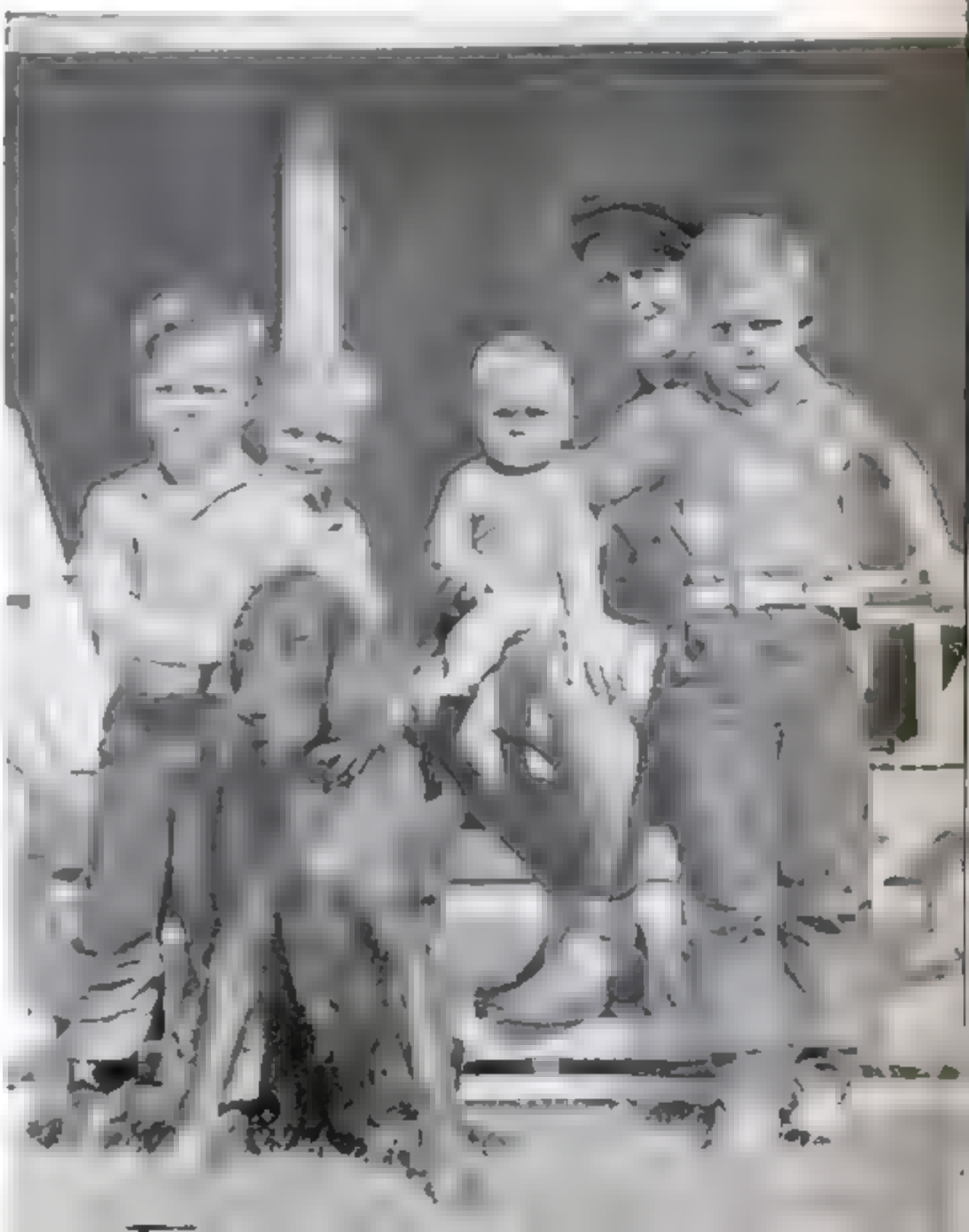
Remember my warning not to shoot into open background. That means, simply, that with such exceptions as costumes against bare walls, the background pattern and foreground objects should balance the picture both as to width and depth. Virtually any piece of furniture may be used in the foreground, such as a sofa or an upended chair. These natural props not only solve the problem of the straying hand by giving it a resting place; they also keep the resulting picture out of the stereotyped class.

Lean an occasional table on its side, for example, and frame a head in the center of the top. Use a low setup, shooting up to get a feeling of distance. The possibilities with furniture are limitless. A few trials will show you the way.

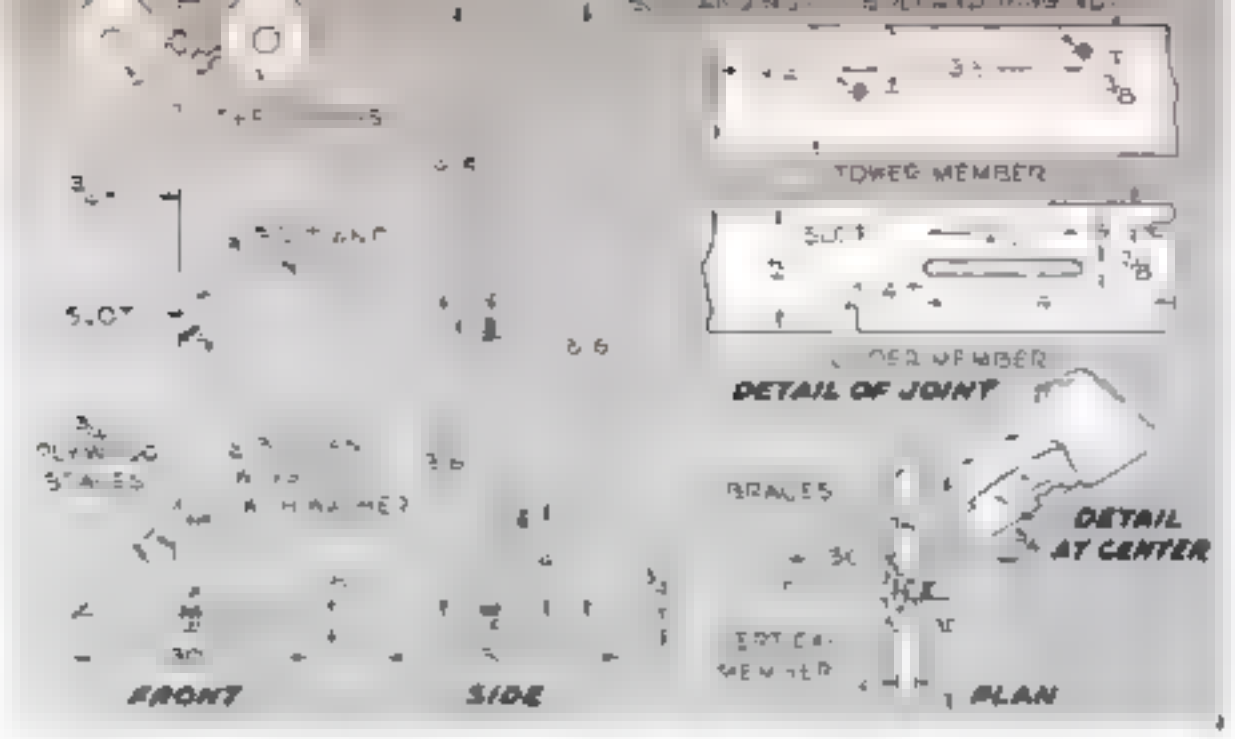
What may you find of interest outdoors? Lattice work, vines, tree branches . . . pictures are everywhere. Let's make them different. The latticed arbor, for instance. Don't simply take a straight shot, but angle the lattice to the boundaries of the negative. If the sun is shining directly through the lattice, try for a silhouette, making sure none of the rays strike the lens.

A human figure will improve the picture, and yet preserve the pattern. In this case, while the lattice will give you a bolder pattern as a result of contrast, you should expose for the subject rather than for the background.

I have left until last the most prized and usually the most poorly conceived picture of all. That's the family portrait. Don't stand all your subjects in a single row, some in shadow and some in the sun, say "look at the camera," and shoot. Do take time to arrange them against an interesting background, perhaps the climbing rose against the living room. Break the straight line by having some sit and others stand, one turned right and another left, some slightly farther from the camera than others. Get them to talk until they relax, and when they seem to be interested in each other rather than in that box at your finger, press the trigger.



Family portrait, 1943 . . . Bing Crosby and his boys present a broken line in this photo, which is far more interesting than the "gay nineties" portraits of a former time, though equally well balanced and proportionate. Note that there are no "loose hands"



Portable Wooden Floodlight Standard Will Support Eight Reflectors

This standard provides support for as many as eight clamp-on flood lamps, and can easily be made at home of non-critical materials. All the parts are of ¾" stock. Blocks are fitted to the ends of one foot, which is made 3" wide at the center and notched on the straight edge. Two plywood braces are screwed fast to this, forming an angle into which the lower upright fits. Join the two legs with a bolt and wing nut so that they can be folded for carrying.

A slot and two bolts permit the upper member to be held rigidly in the extended position or collapsed upon the lower one to take less space in transport. Another bolt and wing nut assembly clamps the lower upright to the larger plywood brace.—CLARENCE N. ALDRICH.

Cheap Bottle-Cap Remover Saves Time in Darkroom

Caps screwed tightly on bottles of photographic solutions to prevent evaporation are difficult to remove by hand. This simple gadget, available at the five-and-ten, saves time and temper in the darkroom and keeps caps in excellent condition for their continued use.—C. H. Coles.

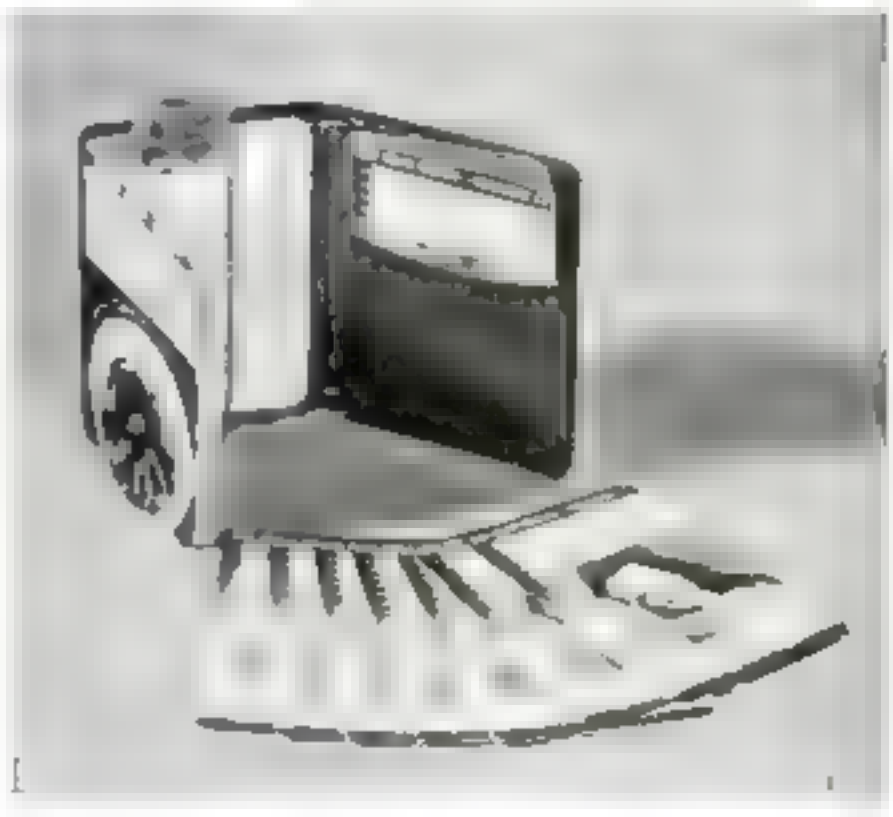
Pointer Cemented to Timer Hand Increases Its Visibility

If you find it hard to see the hand of your interval timer in the darkroom, try cementing a triangular piece of black paper to it as shown in the photograph below. Such a pointer will also make the second hand of an electric clock or any other timing device much easier to see if it is used in the darkroom to measure intervals.—Clifford Leestma.

FOR CAMERA USERS

A SNAPSHOT POCKET FOLDER now on the market will help preserve loose prints that are carried in pockets and handbags. Holding eight prints of sizes up to and including 2⅛" by 4¼", with a separate sheath for each print, the folder is made of durable blue card stock with lettering in yellow. Space is provided on the inside cover for the owner's name and address. The price of the folder is ten cents.

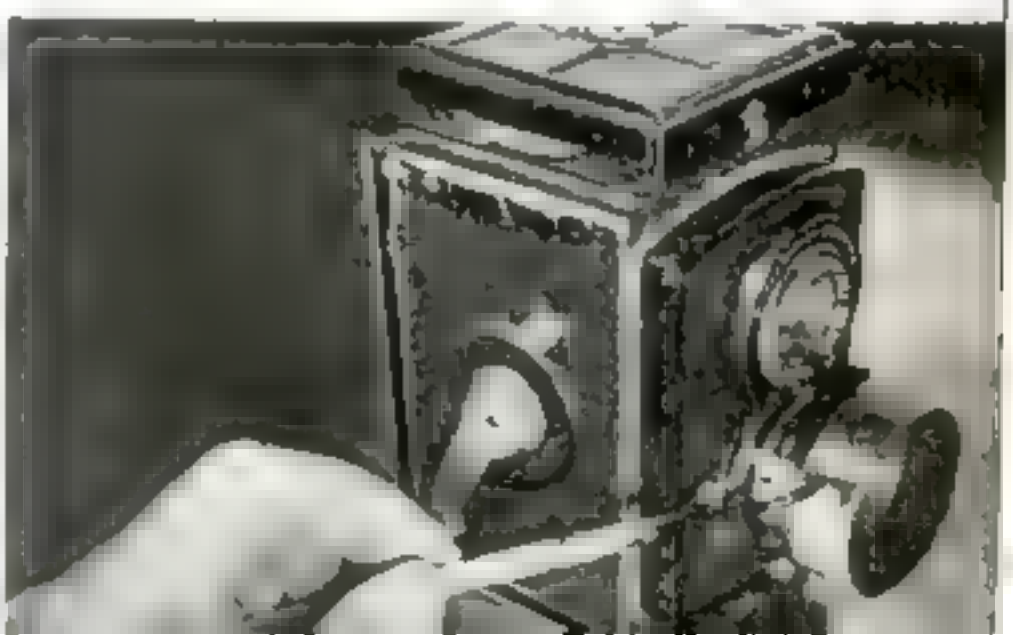
THIS NEW EXPOSURE GUIDE, bound in sturdy imitation leather, includes all important data relative to a popular bromide enlarging paper, plus other aids to better print making. Surface variations are indicated in a handy set of sample prints, a full-range gray scale, and graininess and resolution charts. A dial-type calculator has been included to help in computing exposures. The 32-page booklet which comes with the kit contains full instructions for print making, from checking and calibrating the enlarger to a consideration of artistic effects, with emphasis on securing prints of fine quality. Accurate measurement of enlarger magnifications is made easy by a negative focusing chart.

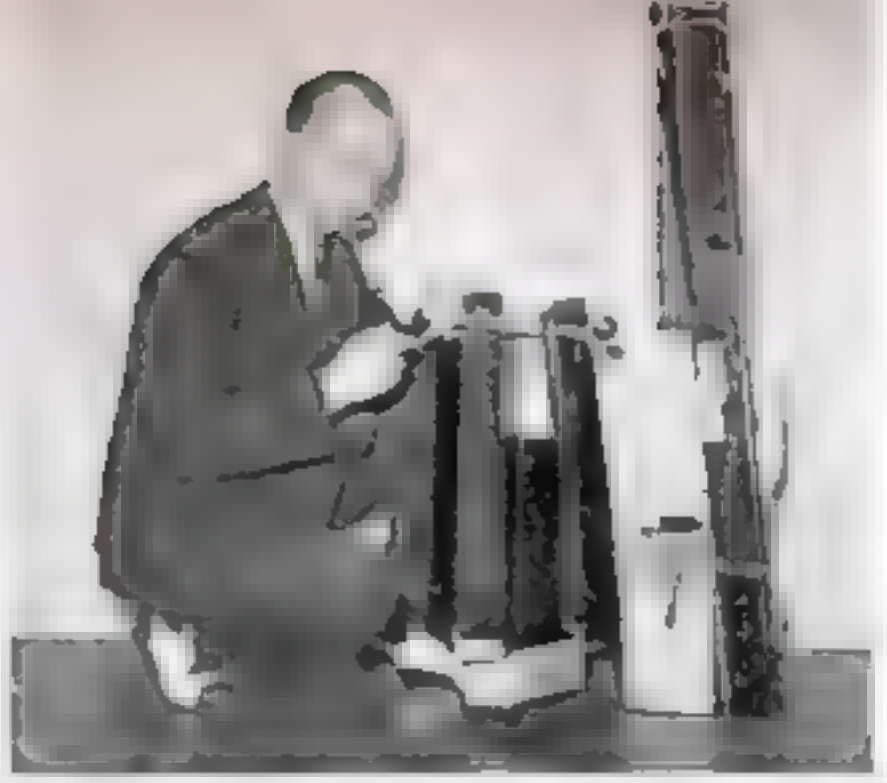


PHOTOS SEALED IN PLASTIC will be of interest to those who want to send durable prints to men in the armed forces. Such photographs, although thin as a paper match and weighing less than half an ounce each, are waterproof, dustproof, greaseproof, flexible, and unbreakable. The customer supplies the snapshot or print, which is placed between two plastic sheets and sealed under thousands of pounds of pressure. The plastic body comes with blue or white borders, and is small enough to fit into the average wallet.

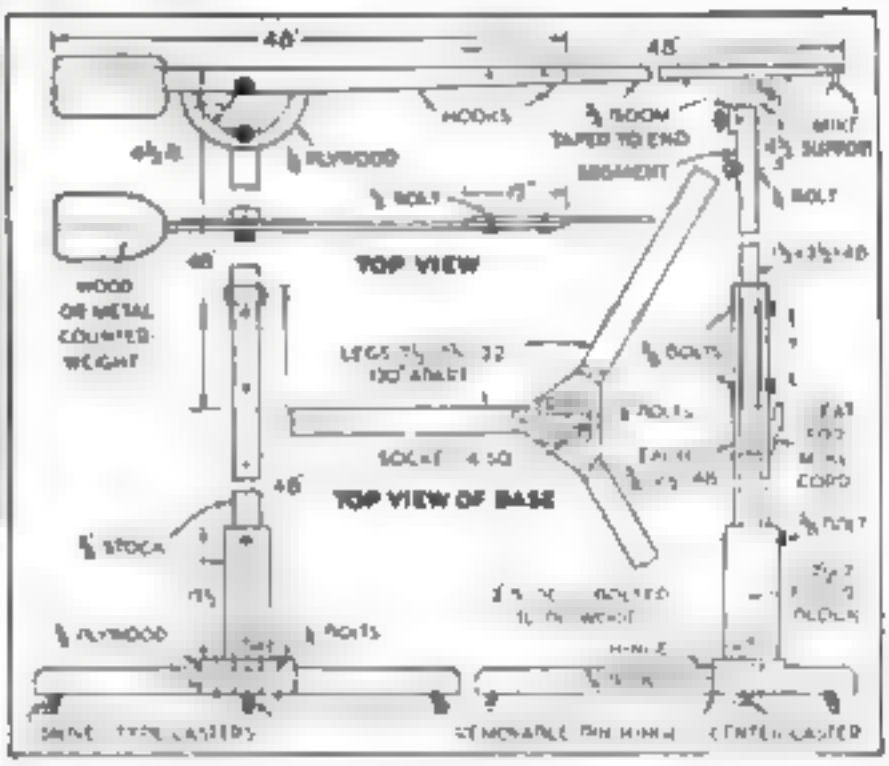
Reducing View-Finder Glare

USERS of twin-lens reflex-type cameras, who place an aluminum lens shade over the lower lens, are often troubled by fogging of the image on the ground glass, due to reflections from the polished outer surface of the metal lens shade. This can be prevented simply by giving the lens shade a coat of dull black paint all over the outside.





Left, the 7' all-wood microphone boom is being adjusted for recording. When not in use, the boom can be folded into two packages, as above



Inexpensive Microphone Boom Built Entirely of Wood

CAMERA clubs making civilian-defense sound movies, as well as many other amateurs, will find ready use for this microphone boom, which was originally designed for the Long Beach, Calif., Cinema Club. Aside from a few bolts, hinges, screws, and knobs, it can be built entirely of wood, a noncritical material. The boom and standard may be taken apart, and the three tripod legs fold upward, making the unit portable enough to be carried by one person

The boom proper is 7' long, and by raising the standard to its full height, you can lift the microphone as high as 12' from the floor. If a 1-lb. "mike" is used, a counterweight of wood weighing only 8 lbs. will suffice. A slotted plywood segment attached to the boom and the vertical standard holds the boom firmly at any angle when two knobs are tightened. Base legs 22" long are sufficient to prevent tipping. A newsreel-type microphone attached to the camera will prove useful in relaying sound from the boom mike to the camera mike.—C. A.

Unusual Action Movie Titles Formed with Salt or Sugar Give Realistic Effect of Drifting Snowflakes

UNUSUAL action titles for winter color movies can be filmed as follows: Put a lamp socket with a photoflood bulb inside a small wooden box open at the top. Lay a sheet of glass over the top, and on the glass place a sheet of blue cellulose film. With either salt or sugar form the title desired. Mount a second flood lamp to give side lighting.

Focus the camera on the title and run off a few feet of film. Then, with the camera running, have somebody blow gently across the title, blurring the lettering until it finally dissolves. In this way you can get an excellent replica of a snow storm, indistinguishable from the real thing if you go about it carefully enough.

Other novel titles for beach and desert sequences can be filmed in the same manner. If the film is reversed, the title will seem to form itself.—MARION SCHWERMAN.

Tin-Plate Reflector Lights Enlarger Stop Markings

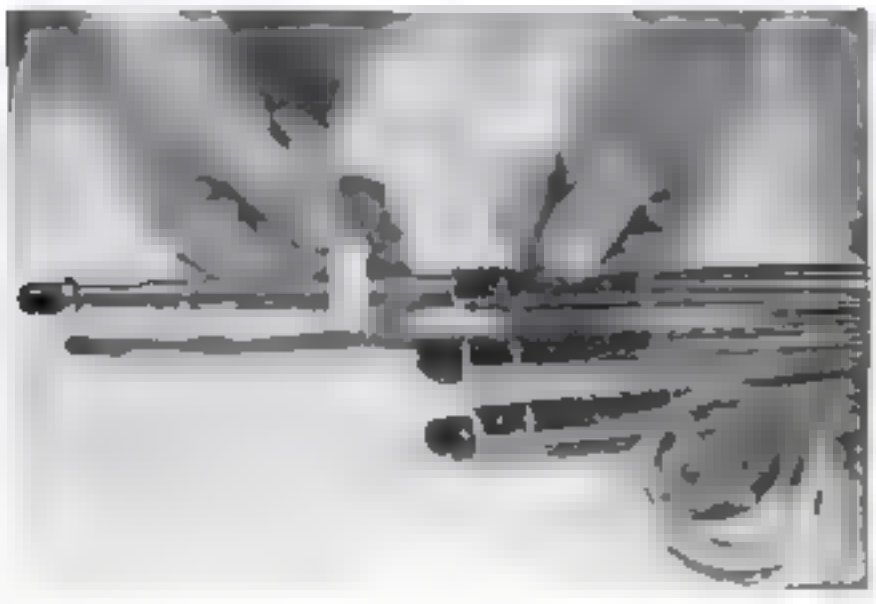
MANY photographers find it hard to read the diaphragm stop numbers on the lens barrel of an enlarger in the feeble light of a darkroom lamp. A reflector cut from a piece of 2" by 5" tin-can metal and bent as shown solves the problem. When it is held under the lens, light from the enlarger itself is reflected around the barrel to the flange bearing these diaphragm stop numbers.—JAMES DEITCH.

Film Containers on Wall Form Handy Negative Racks

THE inner cardboard containers of certain commonly used cut-film cartons make handy holders for negatives, enlarger masks, or memoranda when tacked to the wall of the darkroom. They separate negatives that are to be enlarged, or those printed from those still to be printed.—L. H.

Slipping Tank Reel Repaired with Cellulose Cement

SHOULD the collars on the two halves of an adjustable developing-tank reel become so worn that they are no longer a snap fit and the reel will not remain set at the desired width, apply a thin film of cellulose or model-airplane cement to the inside of the outer collar. Repeat, if necessary, to build up the thickness of this part until it fits the other collar closely enough to prevent slipping.—GEORGE S. GREENE.



Tape Allows Exact Adjustment of Tripod Legs for Height

MOST metal tripods do not allow for adjusting the legs to exact height. To make such adjustment, as for copying and certain other types of work, pull out the sections to the necessary height, then wrap a short piece of adhesive tape around the unsecured section of each leg. This will prevent further telescoping for as long as may be necessary.—W. KIRK.

HOME AND WORKSHOP

Since early in 1941, *Popular Science* has been privileged to offer a series of woodworking articles by Joseph Aronson, of New York, who specializes in interior architecture and furniture design. In his workshop-studio have been created the furnishings for some of the finest modern interiors in the country. By following the plans of this distinguished designer, such as those for the dressing table and bench described in the accompanying article, the home workshop enthusiast can be sure of authentic styling at sound yet simple construction.

Dressing Table and Bench

By JOSEPH ARONSON
Author of The Encyclopedia of Furniture

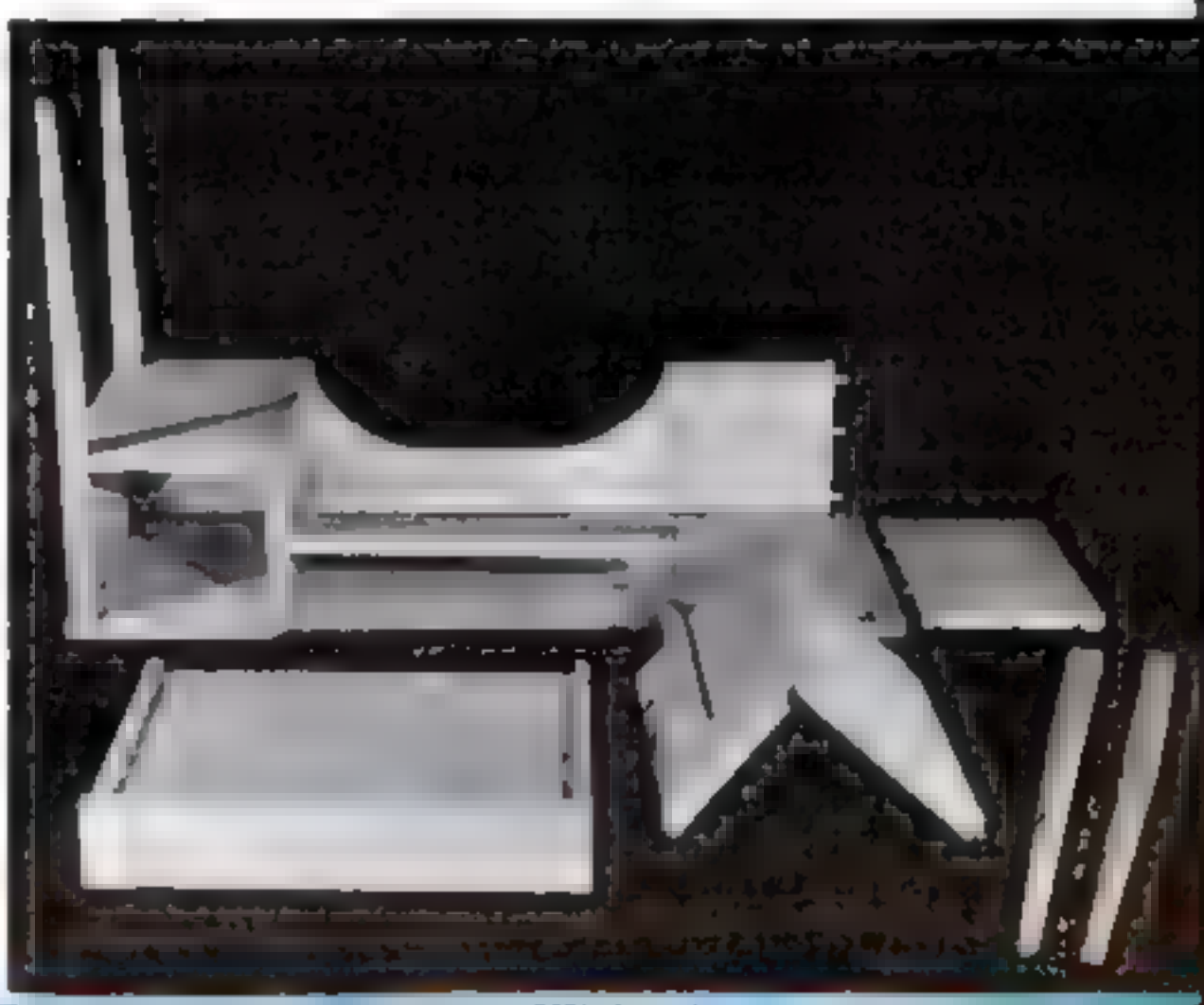
OF MODERN design with simple lines, this dressing table has a charm and delicacy that will make it a most acceptable gift.

Begin with the four legs, which are identical, by first cutting the two adjoining tapered sections of each, then rounding the outer corner on a ⅜" radius. All four sides of the two shelves or "pockets" are perfectly rectangular, and are doweled into the legs or back as the case may be. The two pocket floors are notched to receive the inner sides and legs.

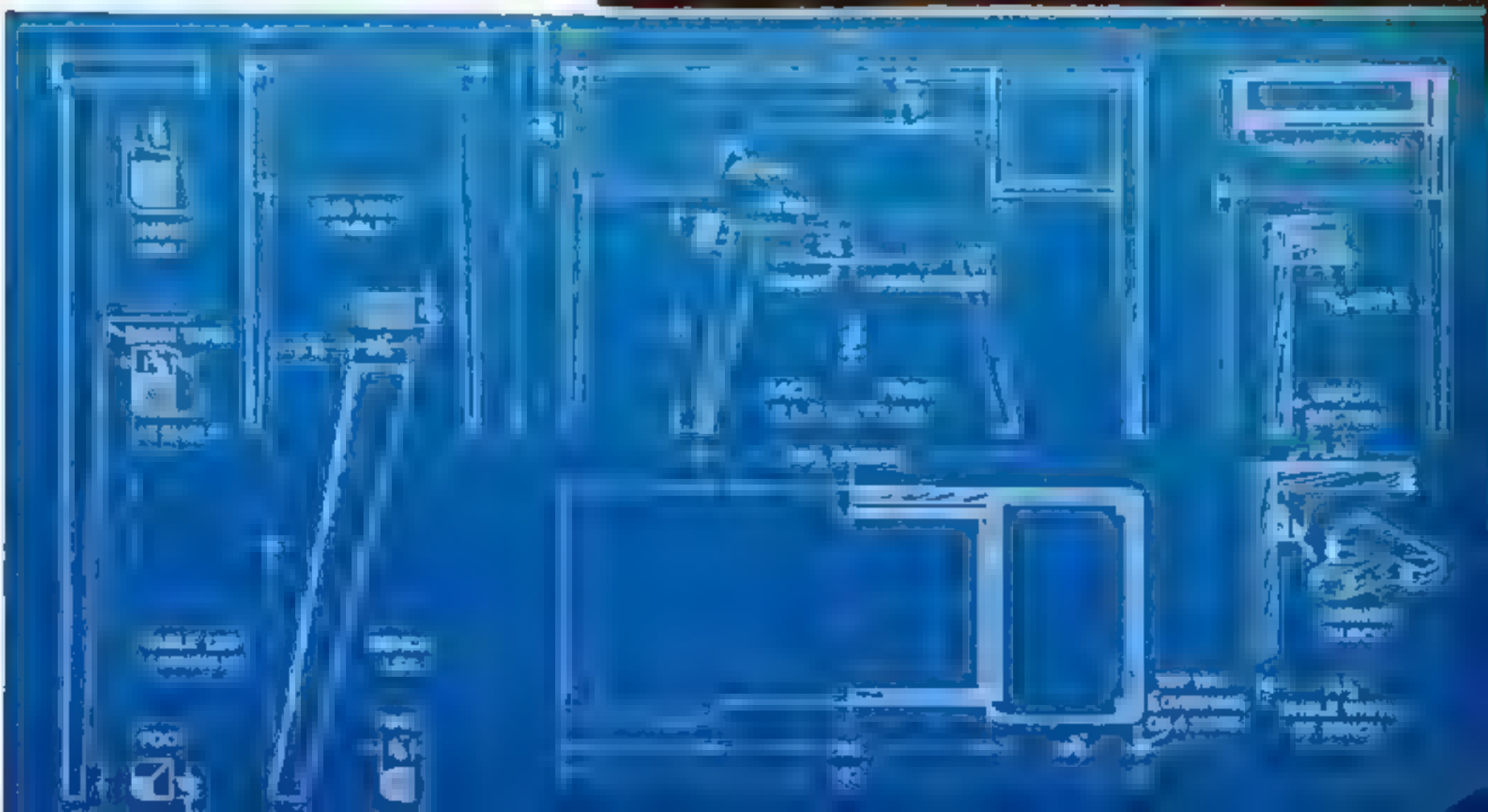
Next, band-saw the back member to shape. The drawer stretcher is doweled to the two inner sides, and the drawer guides, or runners, are screwed and glued on. Dowel the top down to the assembled framework, and glue up the whole construction. Assemble and fit the drawer last, making it to slide freely.

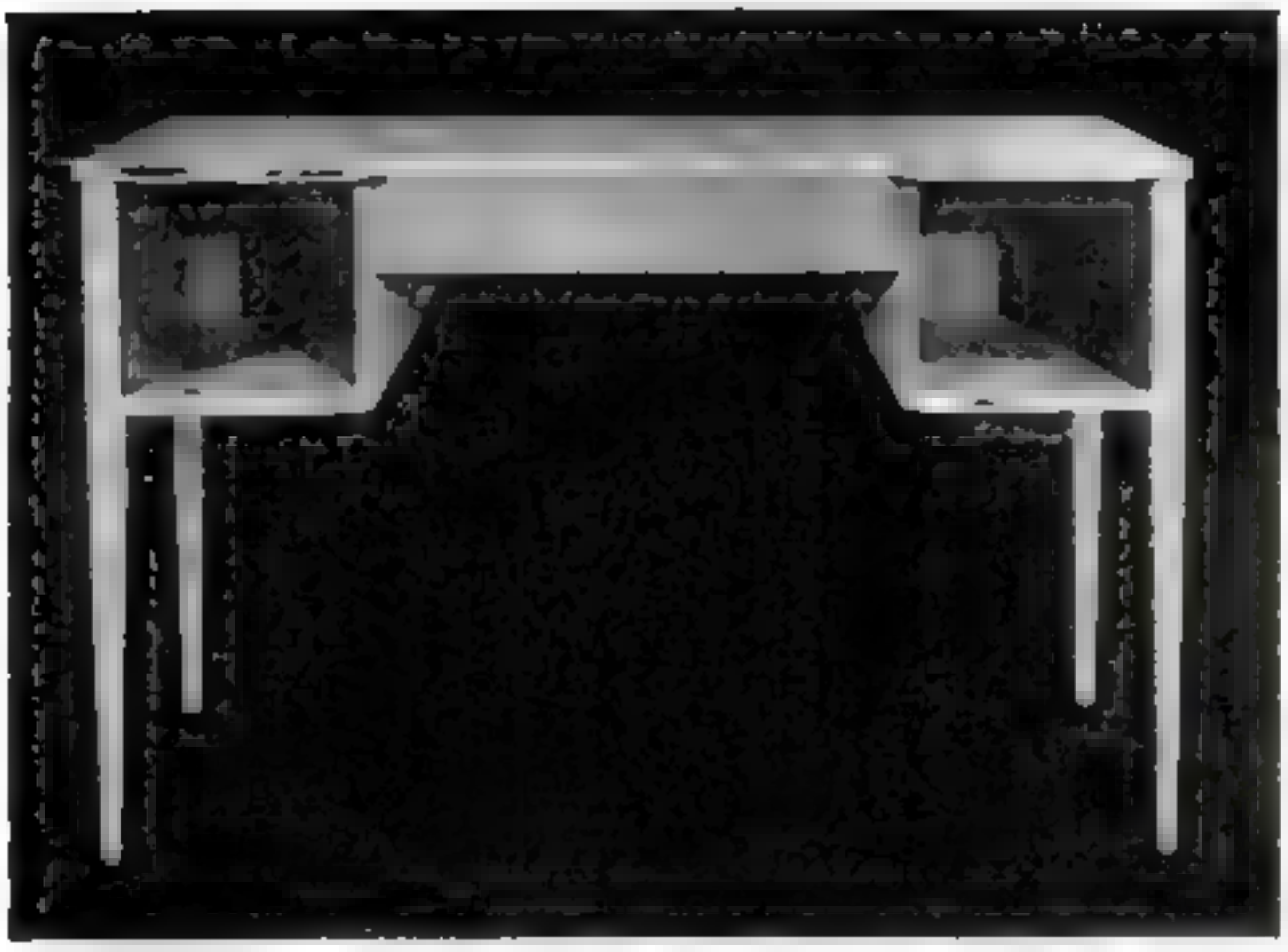
A variation is possible, if more drawers are desired, by making drawers to fit the two pockets.

Either plywood or solid lumber may be used, but where wide boards are required, as in such casework as this, cracking may occur with solid wood, and plywood often proves better. Its edges can be finished in a harmonizing color—blue in the case of the



Shown at right is the modern dressing table partially assembled. Note that the floors of the pockets are notched to receive the legs and inner sides. The drawer, foreground, is supported between these two rectangular pockets and should be made up and fitted last





The assembled bench. It was finished in a modern "pickled" effect by brushing on white casein paint, wiping it off when tacky, and applying two thin coats of white shellac. The edges of the top and pockets were painted blue

original table. All the other parts were given a coat of white casein paint, which was entirely wiped off when tacky; then given two thin coats of white shellac, which were sanded and rubbed.

In the bench, the long frame of the top is half-lapped into the legs, and then braced with corner blocks. Pull webbing or tape tight across the opening in the frame, interlacing the bands and tacking well. Then lay on about a 1½" thickness of hair or cotton felt, and stitch it down. Cover this first with muslin and then with upholstery fabric.

LIST OF MATERIALS FOR MODERN DRESSING TABLE AND BENCH

DRESSING TABLE

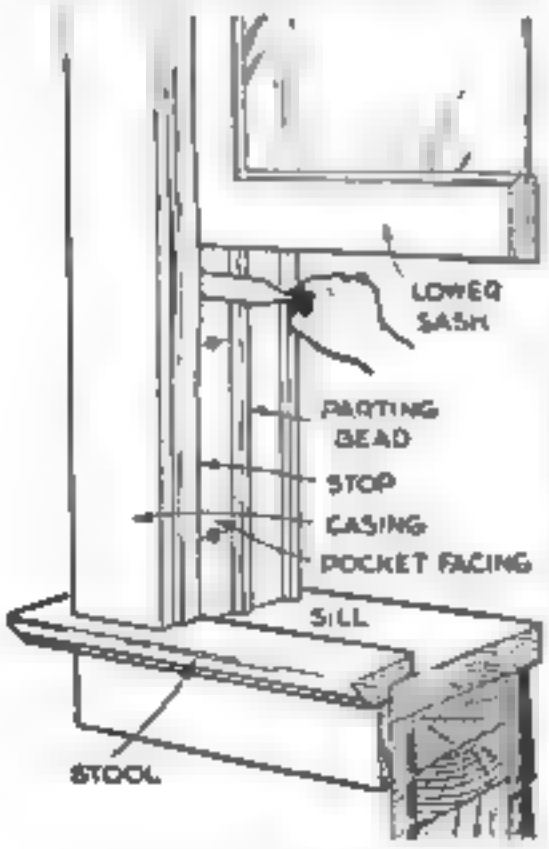
No. Pc.	Description	T	W	L
1	Top (fir plywood)	¾	17	42
1	Back apron (fir plywood)	¾	8¾	38¾
2	Outer sides " "	¾	8¾	13¾
2	Inner sides " "	¾	8¾	14½
2	Shelves " "	¾	10	15⅝
4	Legs (solid maple)	1⅜	1⅜	28¼
1	Drawer stretcher (solid pine)	⅝	3	20
2	Drawer guides (solid pine)	⅝	1	10¾
1	Drawer front " "	¾	5⅝	20
1	Drawer back (solid pine)	½	2⅝	19⅝
2	Drawer sides " "	½	3	14
1	Drawer bottom (fir plywood)	¼	14	19¼

BENCH

2	Curved rails (ash)	1¾	3¼	23¼
2	Straight side rails (ash)	1¾	2	11¾
4	Legs (maple)	1⅜	2¼	16¼
4	Corner blocks (ash)	1⅛	4	4

Note: All dimensions are given in inches.

REMOVING LOWER WINDOW SASH [*SHIPSHAPE HOME*]

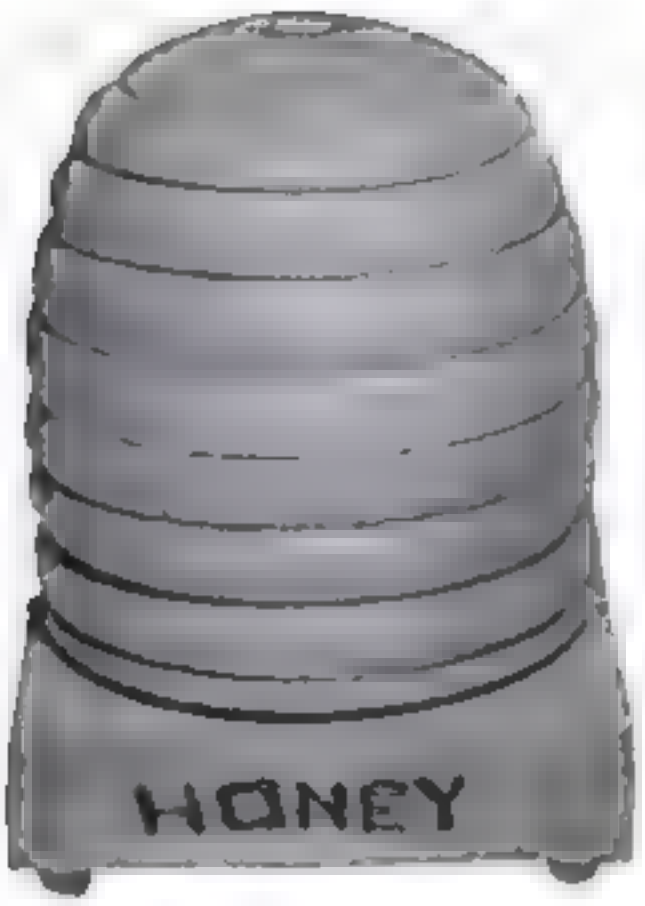


When a weight cord breaks, the stop strip or molding on that side must be taken off. If screwed on, remove the screws and spring the strip outward at the center to prevent the ends from marring the finish at top and bottom. If paint holds it, place a block against the inner edge and tap with a hammer. A knife point may be run along the joint with the pulley stile to slit the finish and prevent chipping. If the stop is nailed, pry the center from behind with a wide chisel and pull the nails out from the back with pliers in order to avoid chipping the surface by driving the nails back through the front. The sash may then be swung out.

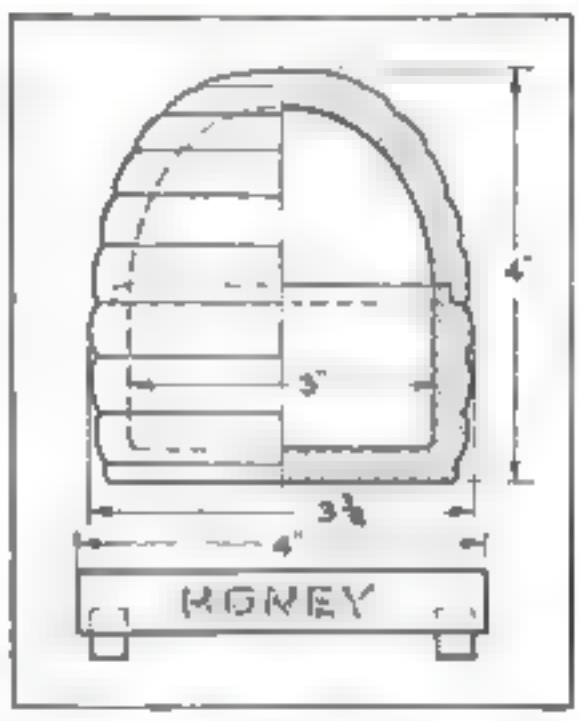
Later, in replacing the stop, spring it back into its former position. If the window was loose enough to rattle, set the stop a little closer, with just enough clearance for easy running. Keep the lower end far enough back to cause slight binding when the sash is closed. If nails are used to fasten the stop, set them and putty with a composition colored to match the finish.

POPULAR SCIENCE MONTHLY SHOP DATA

Honey-Jar Holder Turned from Wood Resembles Old-Fashioned Beehive



A bowling pin was the raw material for this honey-jar holder, but blocks built up of maple rings will serve the purpose equally well



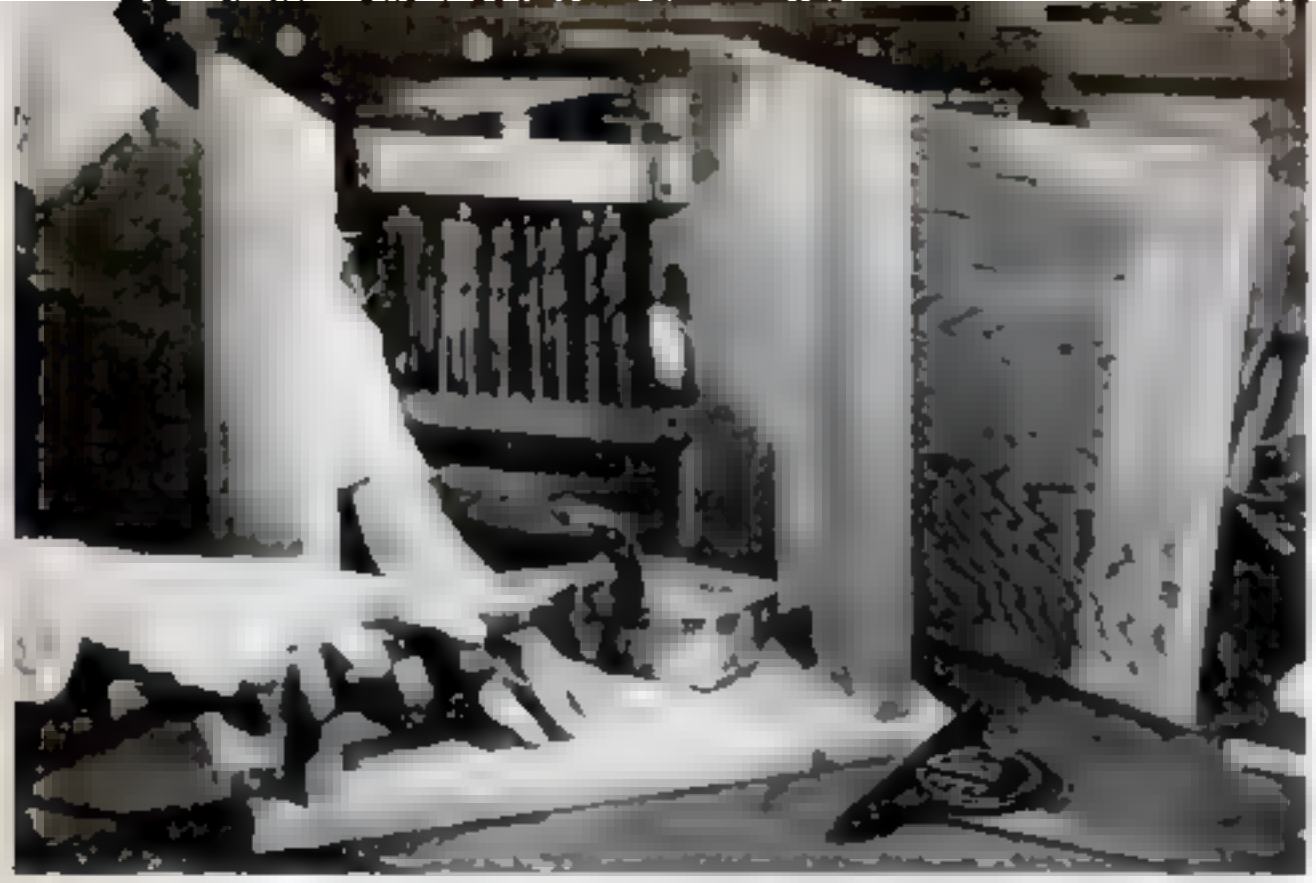
APPROPRIATELY enough, this honey-jar holder takes its shape from the old-fashioned straw beehive. Glue up two turning blocks from maple rings. Mount them both on waste-wood faceplates, and rough off the outside of each. Next, hollow out the inside, remove the backing from the top part, fit the two halves together, and mount them between centers in the lathe. Turn the outside of the hive as a single unit. Finish by French polishing in the lathe; then turn a trifle off the joint to make an easy fit. The base is simply a 4" square of 1" maple stock. Four short legs are cut from ¼" maple dowel and glued into holes at the four corners. Fasten the base and the hive together with dowels or wood screws.—ELMA WALTNER.

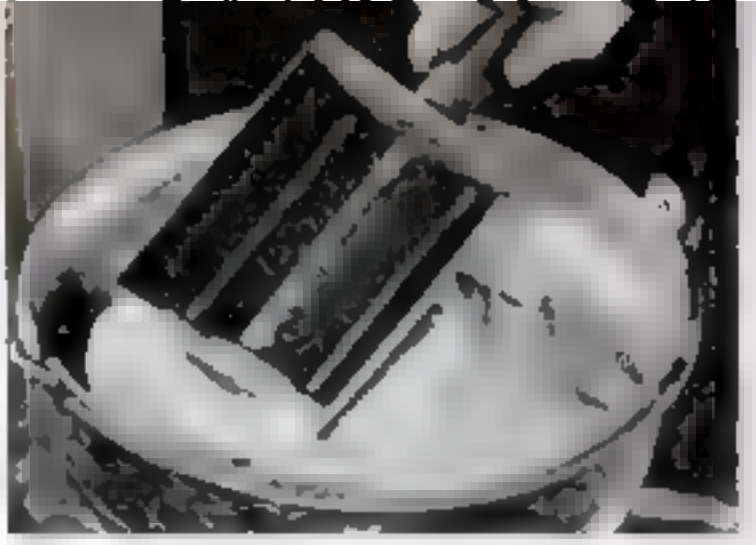
Card Deck Forms Sanding Block for Irregular Surfaces

WHEN sanding grooved surfaces or irregular edges, you can often do the job more easily by using an ordinary deck of playing cards as a sanding block. Folded around them, the sandpaper adjusts itself to the contour of the wood, reaching every surface. In the photograph at right, the cards are pushed down on the sides of the deck to sand the recesses of a roll-top desk.—W. S.

Croquet Mallet Used in Shop

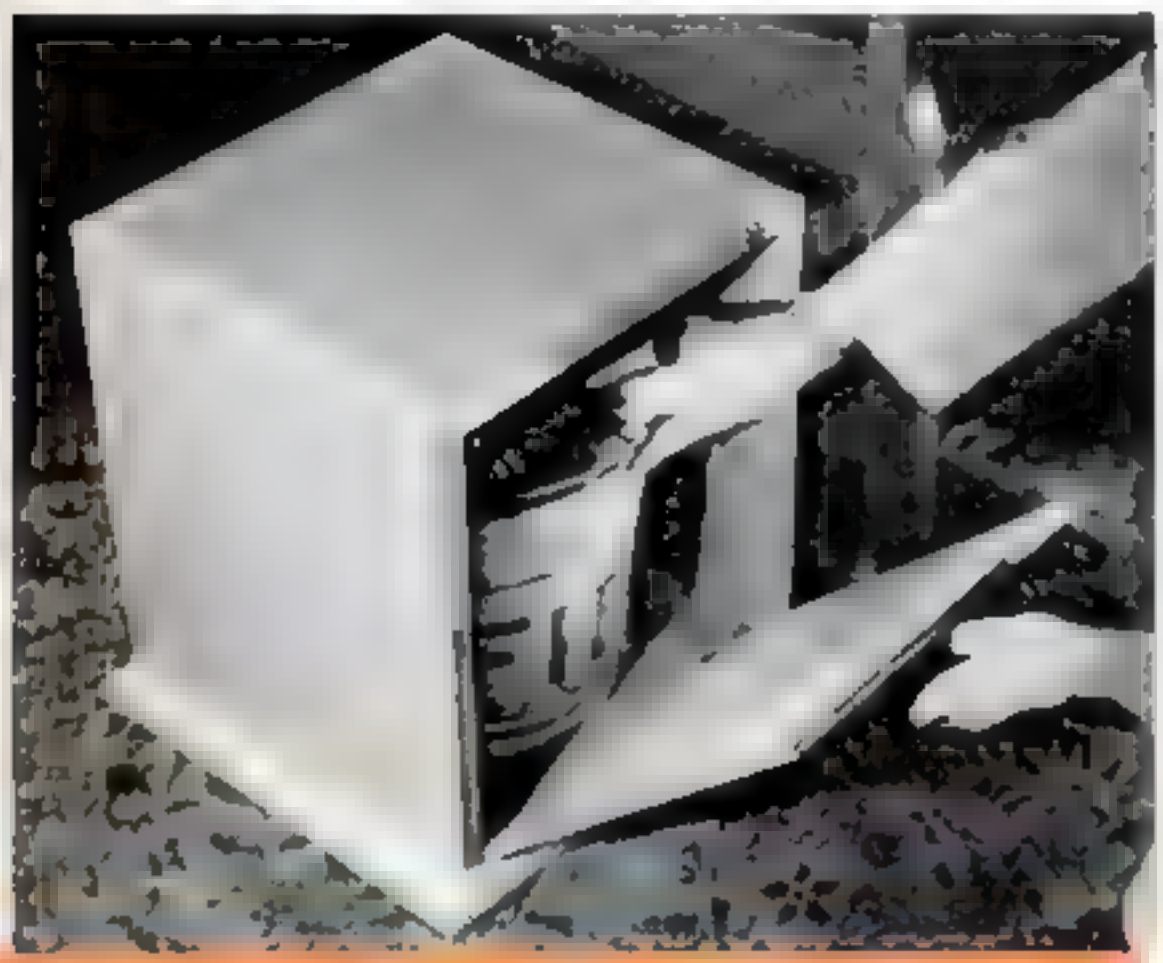
IT IS usually the stem that breaks on a croquet mallet, but the head will make a serviceable shop mallet if the handle is trimmed short below the break, or replaced with a new one about 9" long. One or both ends of the head can be faced with leather, felt, or other protective material, if you so desire.—R. WOODBURY.





A sand scoop may be made from an old tin can and two wooden pieces. If ava i-able, a small stove shovel may be used

Photograph at left shows cabinet being assembled. A strip of wood for support-ing the back panel is be-ng na led into position. Even scrap lumber may be used



A slight pull on the door handle will remove the entire panel, thus permitting the sand bucket to be taken out quickly, without undue interference

DOOR-PANEL DETAIL

"TIN-CAN" SAND SCOOP

This easily constructed a full-sized pail and useful piece of parlor

Fire-Bucket

SAND bu kets, which should be in every home for use in fighting fires and s thering incendiary bombs, are not particularly attractive objects. But when paced in an easily made cabinet, such a bucket can remain on duty in the swank-est living room or anywhere else. Be-sides making the bucket instantly avail-able in an emergency, the cabinet does duty as a chair-side stand, taboret for supporting flowerpots, bedside table, or orner whatnot holder

The cabinet illustrated, which houses a bucket containing 25 lbs. of sand, was made largely from odd pieces of ¾" red-wood The following lumber was used

2 pc ¾" by 13¼" by 14 1/16" for sides,
1 pc ¾ by 13 ¼ by 13⅜" for top,
1 pc ¾ by 14¼ by 15 ½ for bottom,
2 pc ¼ by 12 by 14 fir paneling, 3-ply for door and back
1 pc 1 maple dowel, 2 long, for handle
1 pc ¼ by ½" by 65" for back rabbet and door stop

cabinet houses doubles as a furniture

The attractive cabinet pictured below houses a sand bucket for use in combating fires and incendiary bombs in the home

Cabinet for the Home

With a plane and sandpaper, round the upper edges of the bottom in the front and at both ends, and the upper edges of the top all the way around. Use finishing nails to fasten the parts together, and set the heads about ⅛" deep. Fill all exposed holes with plastic composition wood or crack filler. Nail the narrow wood strips around the inside surface of the box, a shade more than ¼" from the rear edges of top, sides, and bottom, to form a recess for the back panel, which should be secured with glue and brads. Nail a similar strip across the underside of the top ⅝" from the front edge, to act as a stop for the door.

Instead of being hinged, the door is provided with two pegs in its lower edge that fit into holes in the bottom. The pegs are made by driving fairly heavy nails into previously drilled holes and cutting off the heads about ⅛" from the wood. Smooth the cut ends with a file. The holes are, of course, located so that the panel is inset an equal distance (½") all around.

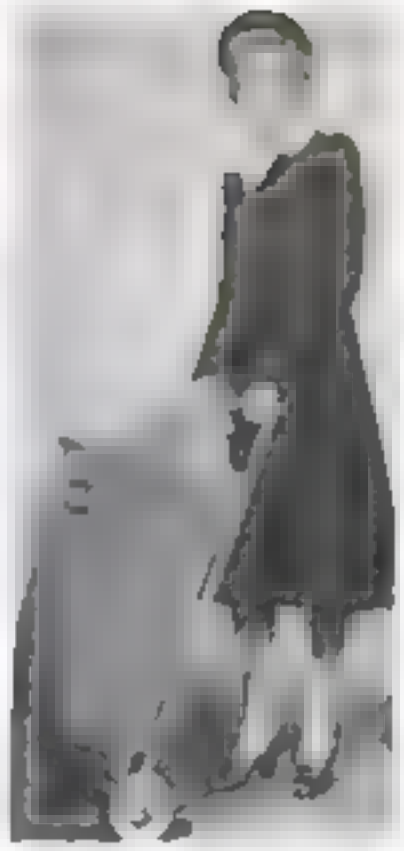
With a roundheaded nail or escutcheon pin and a bit of springy sheet metal, make a friction catch as shown. A commercial ball catch may be used instead, if not too large for the thickness of the panel. The handle, a length of 1" dowel, is fastened with two screws 2⅝" from the top edge. Adjust the friction catch so the panel snaps in and out easily. In case of an emergency, a pull on the door handle removes the panel entirely, leaving nothing to obstruct removal of the bucket.

The door is decorated with the insignia of the Auxiliary Fire Fighters, a red Maltese cross in a white triangle on a blue disk. An easy way of making this decoration is to paste the blue disk segments and the cross on a piece of white paper, gluing this to the door after painting. A coat of clear lacquer or varnish will protect the design.

Included with the sand bucket should be a small stove shovel or other suitable scoop. You can make one from a tin can as shown.

By WALTER E. BURTON

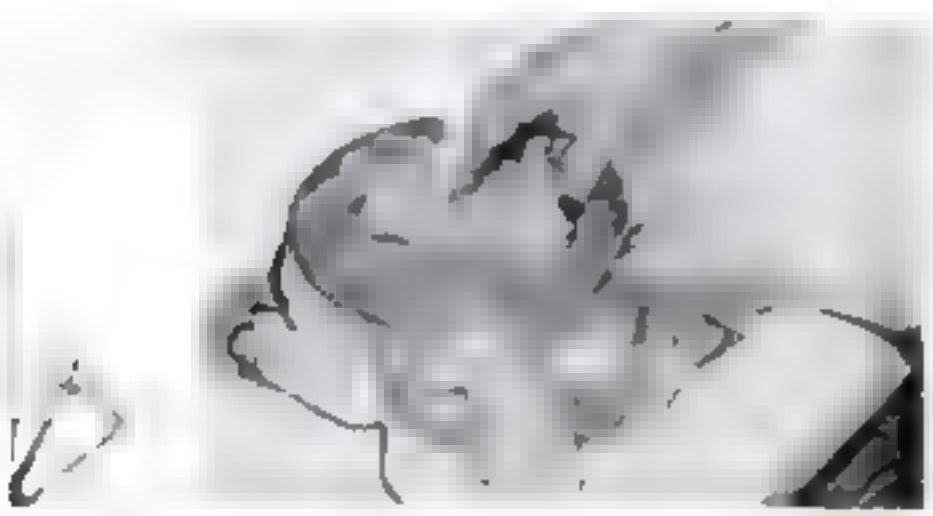
Housekeeping Aids



CASH AND CARRY is the vogue these tire-saving days, and a smartly styled shopping cart will help you roll your own! Strong and spacious, yet compact and light, these useful carryalls may be obtained in composition wood or durable canvas. They may be pushed or pulled with ease and occupy a very small parking space, while bag at right is collapsible when empty. The hardwood wheels are splitproof and will not wear down unevenly

THIS FLOATING THERMOMETER determines the correct washtub temperature for various types of fabric. Doughnut size and ringed with a soft collar, it has a scale for cold rinses, too

YOUR LEFTOVER PROBLEM is neatly solved by these leakless wax-paper containers which may be marked with their contents and stacked in your refrigerator. They're also good for box lunches



FROM THE CARIBBEAN area comes this fiber-meshed scouring pad to replace hard-to-get steel wool. It is long lasting, cannot rust and will not splinter or cause injury to hands, nor scratch the fingernails

ALL-PLASTIC AND ALL-PURPOSE aptly describes the 17-piece kitchen utility set shown below. Individual articles are molded in one piece out of crystal-clear synthetic material. They will not break or tarnish

MOPPING-UP OPERATIONS are simplified by pressing the mop into an adjustable drainer that fits any pail, eliminating hand-wringing and splashing. Mop and drainer come as unit

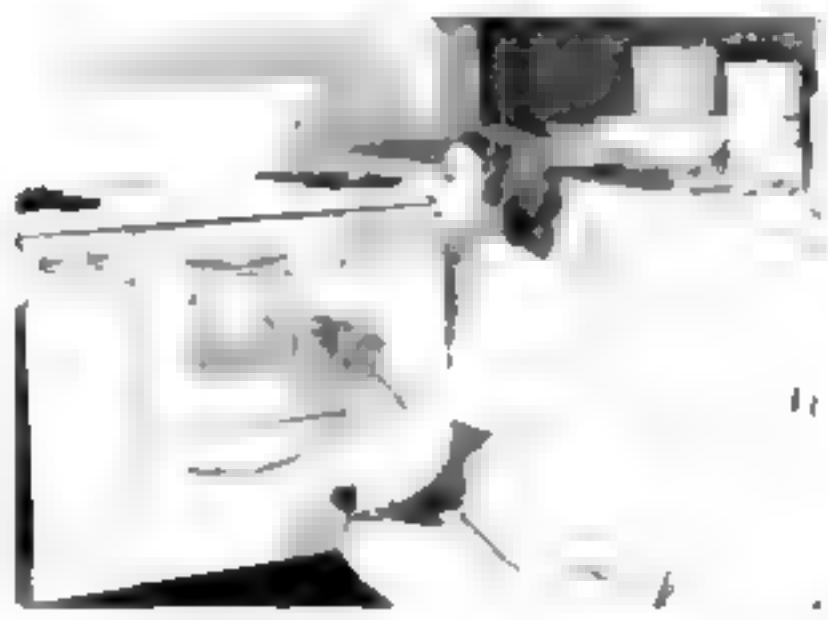
A FURNISHING FEATURE for porch and parlor alike, and particularly well suited to small-type defense homes, this knockdown lounging chair is purchased in a carton and put together at home. It is made of noncritical materials and may be obtained in wine, beige, green, turquoise and blue

Picture as it is seen in ordinary room light

Same picture glowing in complete darkness

A DECORATIVE NOTE for the bedroom or nursery, as well as a means of overcoming a child's fear of the dark, is provided in these luminous pictures. After brief exposure to daylight or electric illumination, they glow in the dark for about four hours. Transfers for mounting directly on the wall are also available

THINGS TO COME in household ranges will include an oven door fitted with a specially heat-treated plate-glass window, allowing the homemaker to bake her cake and see it, too. Heat loss occasioned by opening the door is eliminated, and the danger of burning the baked goods is cut to a minimum



REFRIGERATOR CARE

Always wipe up at once any food spilled inside the refrigerator. Food acids may otherwise stain the finish.

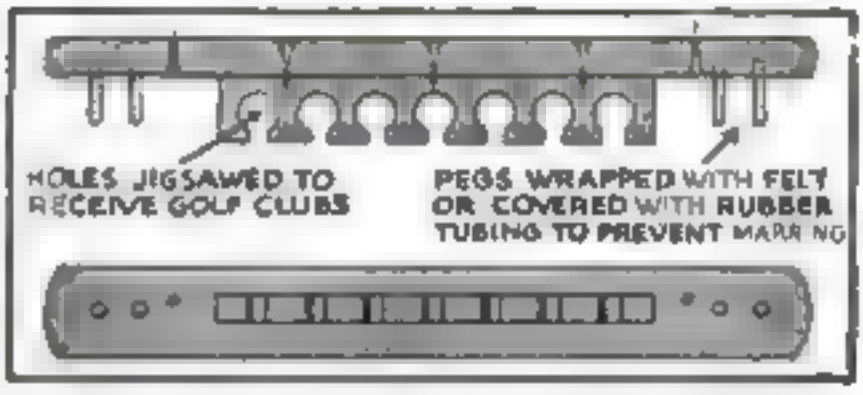
Never use any sharp instrument to break trays loose from the freezing compartment.

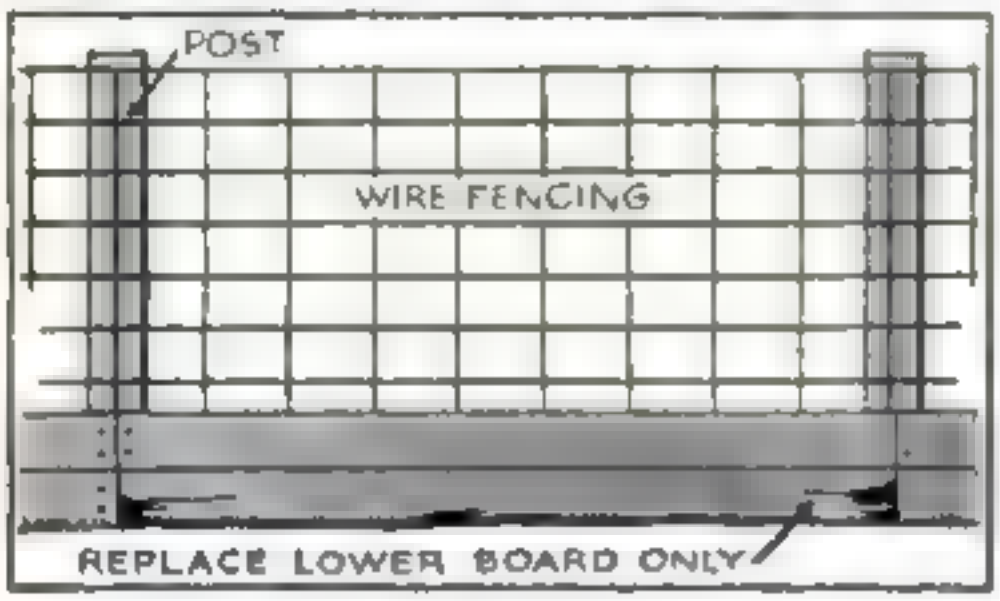
Mild soap and warm water are good for cleaning the outside of the cabinet. Don't use abrasive, gritty cleaners. Nonporcelain finishes should be waxed three times a year with a good liquid wax.

Check the door for air leakage by closing it on a piece of ordinary letter paper. If the paper pulls out without appreciable drag, there is excessive air leakage. Have an authorized dealer make any necessary adjustment or replacement. Touch the door gasket as little as possible.

Tennis Rackets, Golf Clubs Stored in Homemade Rack

HERE is a simple wooden rack protecting your tennis rackets and golf clubs from warp or damage, yet allowing them to hang free. Design it according to the size and number of pieces to be stored, and hang it in a room or closet of even, moderate temperature. Be sure to wipe the heads of golf clubs with an oiled cloth to keep the metal from rusting while in storage, and put tennis rackets in their waterproof cases and presses for additional protection against dampness and warping.—R. M. WOODBURY.



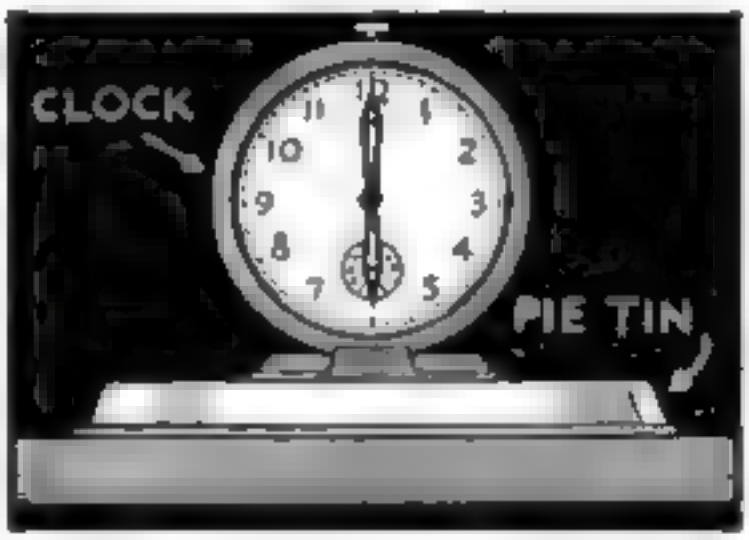


Two-Part Board on Fence Bottom Makes Replacements Easy

WOODEN bottom boards on wire fences have a high rate of replacement due to rot. As shown above, two narrow boards, cleated together, may be used instead of a single wide one, with the fencing attached to the upper strip. The lower board is replaced easily.—J. W. BESSMAN

Pie Tin Amplifies Alarm to Wake Heavy Sleepers

HEAVY sleeper? Try placing a pie tin, turned bottom up, under a spring-wound alarm clock, as shown below. The vibration of the clock on this sounding board will cause considerable racket, probably enough to arouse you.—E. G. MACHAUER.



Hand Cultivator Also Used as Emergency Carrier

A HAND cultivator will serve efficiently as an emergency wheelbarrow for carting loads of medium weight that are too awkward to be carried by hand. Simply invert the cultivator and place a suitable box on the handles, resting snugly against the shares, as shown in the photograph at left.—R. M. W.

Cash Prizes

FOR GIFTS TO MAKE FOR SERVICE MEN

The boys in our fighting forces are eager for the many things that aren't "Government Issue" and cannot be bought in post exchanges. Can you suggest a small, useful, easily made gift? For the best ideas, we will award $160 in six cash prizes

FIRST PRIZE $50 — SECOND PRIZE $25 — THIRD PRIZE $10
THREE PRIZES OF $5 EACH

WHAT SERVICE MEN LIKE

- Apron-type toilet kits
- Button-cleaning and polishing kits
- Cigarette cases
- Compact combination kits
- First-aid kits
- Games
- Name tags
- Photo folders
- Photographic accessory kits
- Pipe-and-tobacco kits
- Pocket snapshot books
- Sewing kits
- Shaving kits
- Shoe-shine kits
- Slippers
- Toilet kits
- Wallets
- Wooden shower clogs
- Writing kits

THE purpose of this contest is to develop projects which any man or woman can make in the home, using noncritical and readily available materials. *Remember—it's the idea that counts, not skilled craftsmanship.*

Mail your entry, or entries, suitably packed and fully prepaid to the Service Men's Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y., to arrive on or before March 1, 1943. No entries will be returned. If, therefore, you wish to keep your model, or if it can't be shipped conveniently, simply send a photo, description, and any essential sketches.

If recent surveys are any indication, men in the armed forces want chiefly compact, durable articles they can really use. The "musts" come before the extras.

The accompanying list will give you some clues as to the preferences of service men, as expressed in various polls, for articles other than the always popular cigarettes, waterproof watches, and portable radios.

Our contest is open to all except employees of POPULAR SCIENCE MONTHLY. The judges will be the editors of this magazine, assisted by a committee of service men to pass upon the utility and practicability of the gifts. Their decisions will be final. In case of ties, each tying contestant will be awarded the prize tied for

A lady to envy! This cheerful good-morning tray is comfortably high, sturdily built, and attractive

At right, 1, spacing dowel holes with jig; 2, aligning dowels by means of notched wood strip; 3, tying dowels in place with cord before assembly

Breakfast-in-Bed

By CHARLES and BERTRAM BROWNOLD

A WELL-BUILT and nicely decorated breakfast tray is not only an attractive gift for milady who enjoys an occasional morning meal in bed, but is also of practical use in the event of illness.

The tray illustrated is made of a panel of ⅛" plywood, glued into grooves in a hardwood frame, the corners of which are half-lapped and glued. If means for cutting a groove are not available, the panel can be held between rabbeted strips and light quarter-round molding

The legs of the tray are topless compartments or "wells" formed by parallel 3/16" hardwood dowels. These are driven into holes drilled into the underside of the frame, and the lower ends are set into corresponding holes drilled into a rectangular piece of ⅝" hardwood.

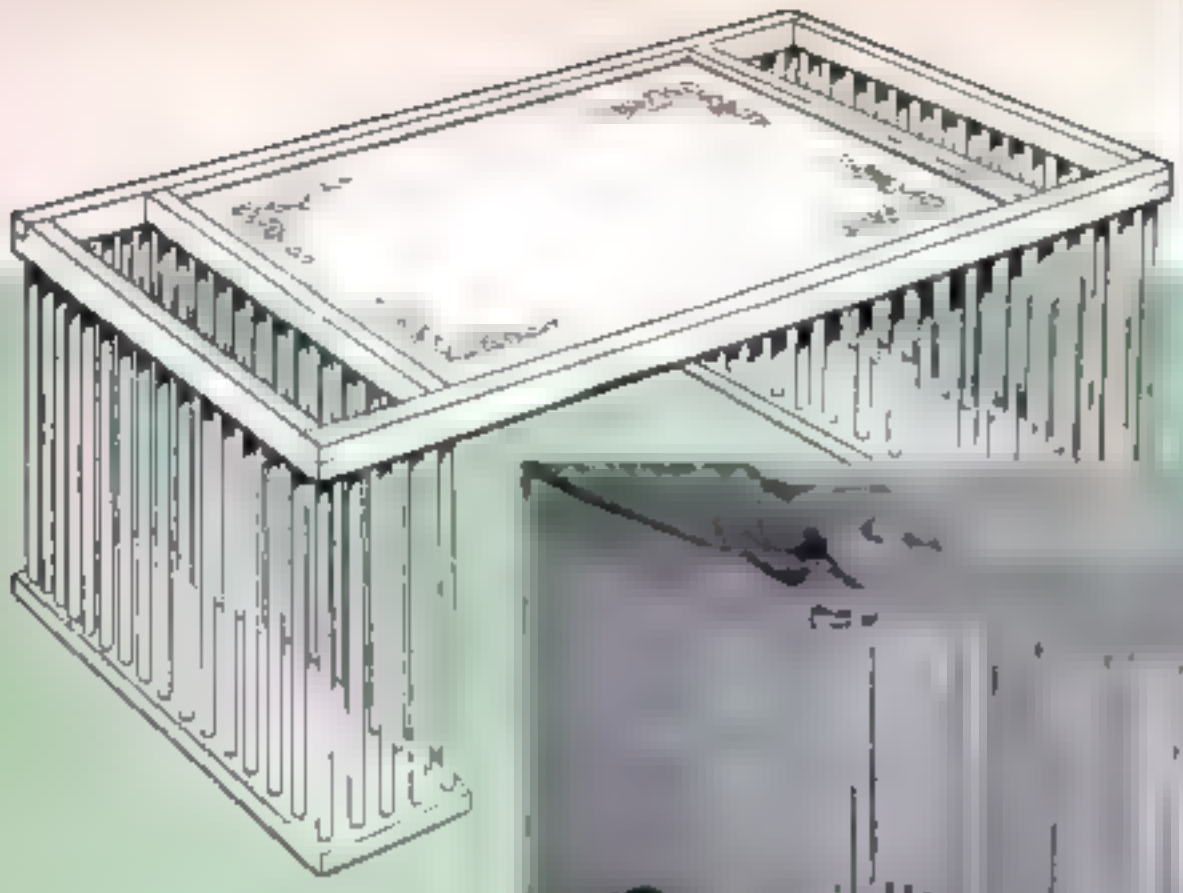
While strict adherence to the dimensions is not necessary, the upright supports should be tall enough and far enough apart so that the tray will rest comfortably over a person in bed. Keep the overall dimensions small enough so that the tray can be carried through doorways without difficulty.

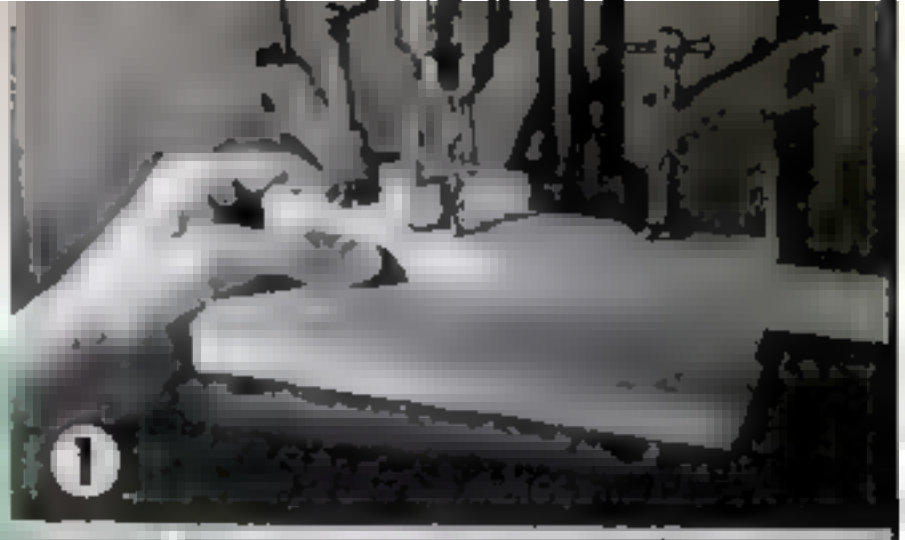
Accurate spacing of the dowel holes can be facilitated by means of a spacing pin in a jig clamped to the table of the drill press. The first two holes are drilled to marks; then the work is put into the jig with the pin in the first hole and the drill in the second. Thus set, the jig is clamped into position. Subsequent holes are drilled by moving the work so that the pin is in one hole while the next is being drilled.

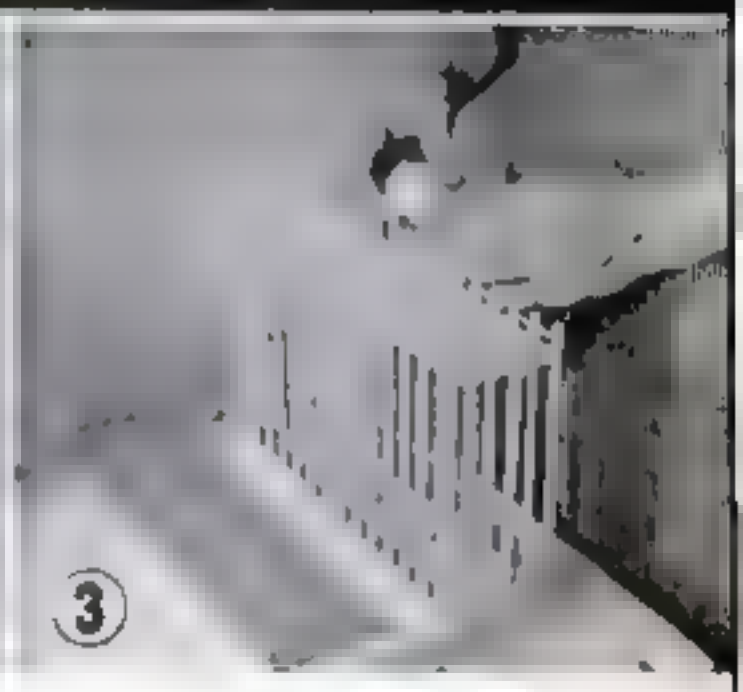
The same method can be used in drilling by hand, but the jig, held in a vise, has two holes—one for the pin and one for the drill. The jig block should be thick enough to hold the drill in perpendicular alignment.

Note that the holes in the frame are not bored through, but only to a depth of ½". The dowels, which must all be accurately cut to exactly the same length, are then driven in.

Now comes the task of placing the lower ends of the dowels in the rectangular bottom pieces. This may present difficulties, since many of the dowels will be twisted or bent, and out of alignment. To simplify this problem, use the through holes in a bottom piece as guides to drill identical holes in a scrap piece of thin, soft wood. Now saw off a strip on all four sides of the scrap piece, centering the cut on the holes. The result is a piece of wood with notched edges, as shown in one of the photographs.





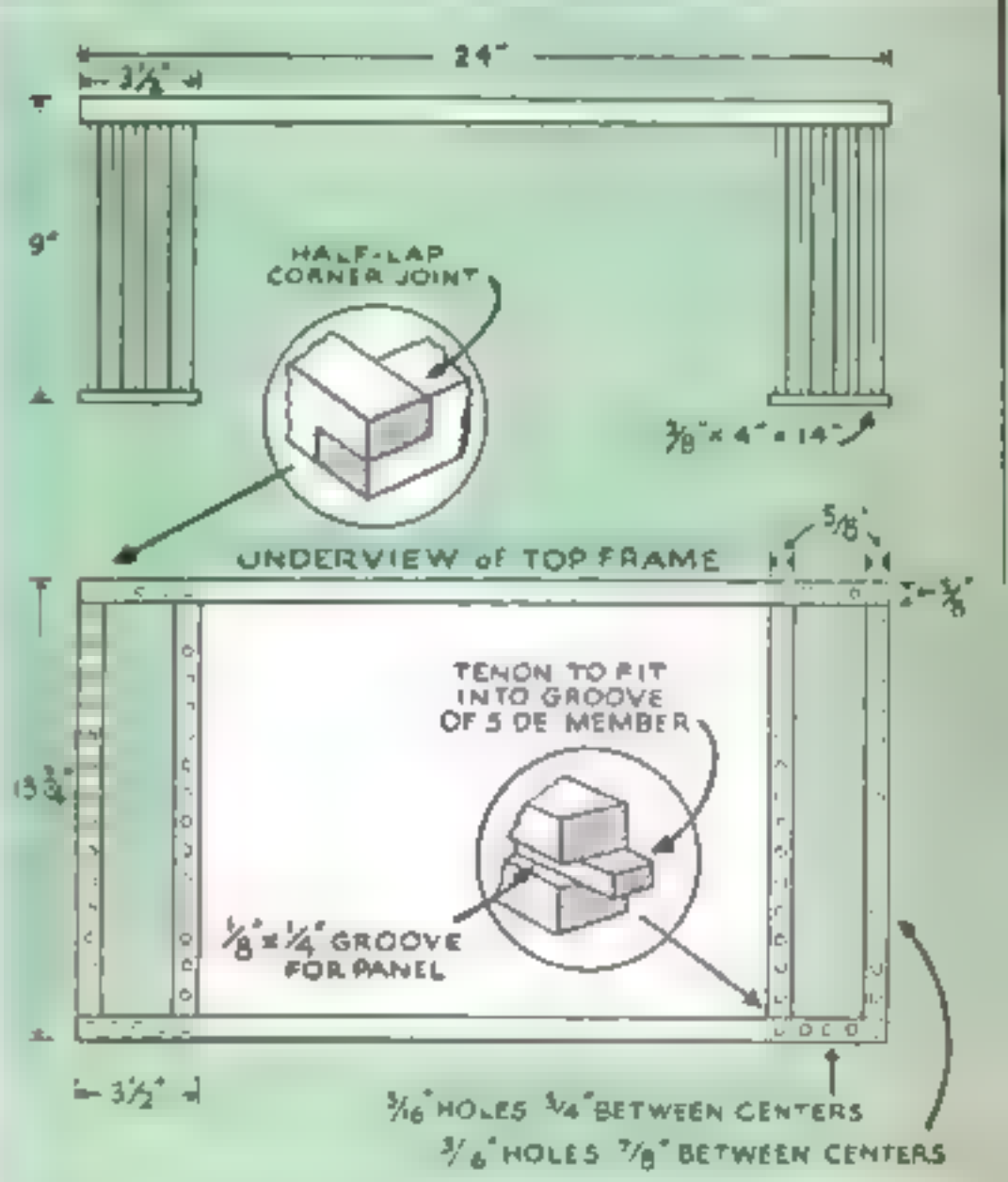


Tray HAS HANDY MAIL AND NEWSPAPER COMPARTMENTS

Place the notched piece between the rows of dowels and fasten the dowels into the notches by means of string tied across them After the dowels have been tied in place, the bottom piece can be put on easily. The scrap piece is then removed by cutting it up with a saw passed between the dowels.

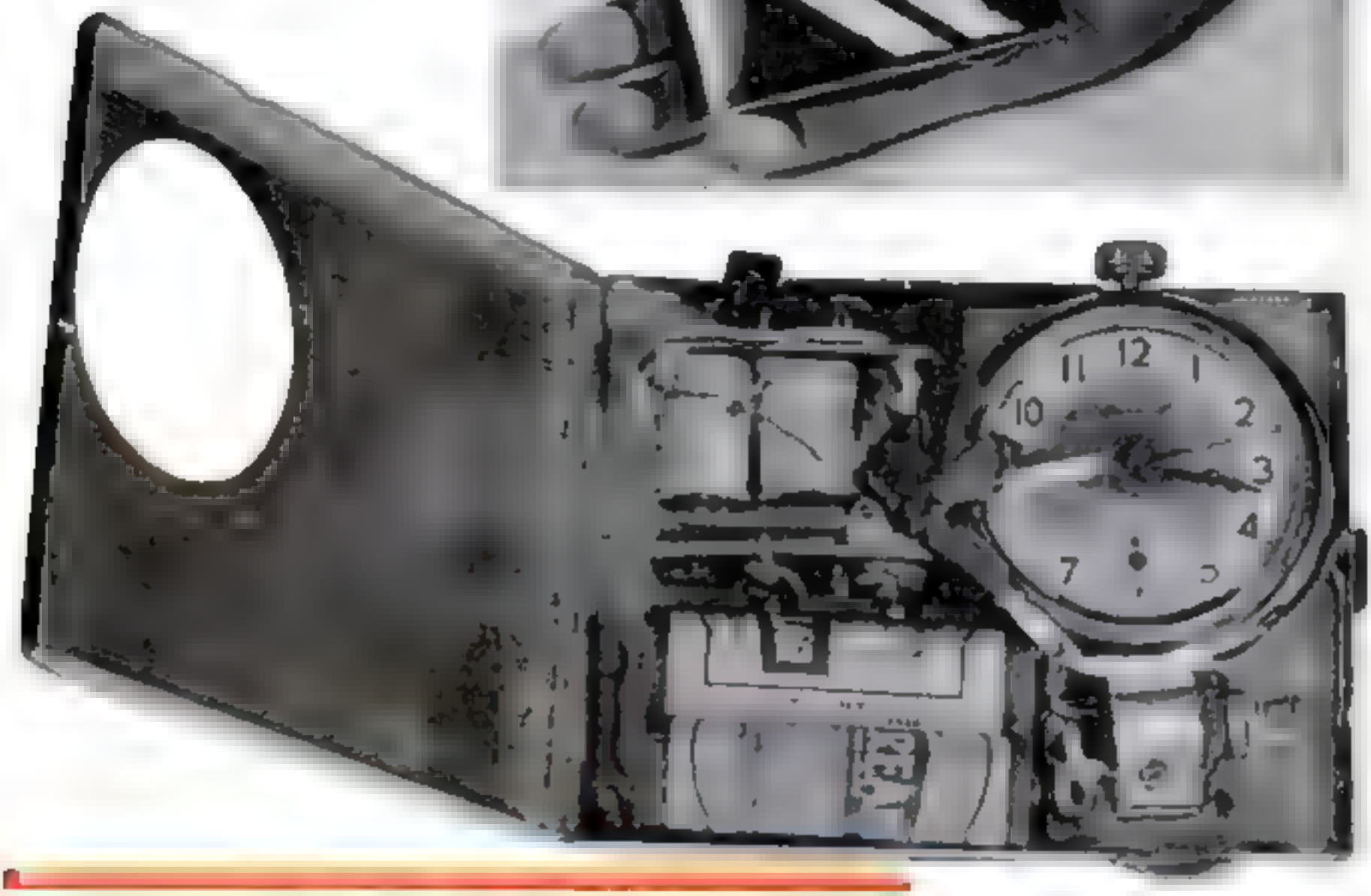
Another method of aligning the dowels is to lay the bottom piece on the frame and, after pushing the dowels through both parts at once, slide the bottom piece down into position. This method requires a fairly easy sliding fit, which in turn necessitates glue Since there are 76 dowels and 152 holes, gluing is a time-consuming job as well as a "fussy" one, because all glue drips must be cleaned off the inside of the narrow "cage." Therefore the first method (assuming that the holes are drilled to provide a driving fit) is to be preferred, since the only gluing required in the whole job is for the panel in the grooves of the frame and for the corner joints of the frame. Incidentally, these corner joints can be strengthened by having the corner dowels run through them

After the upper edges of the frame have been beveled and sanded, the completed piece can be painted, preferably a light, cheerful color. The surface of the tray can be decorated with decalcomanias.



Wakes you up—lets others sleep! This personal alarm is pocket fitting, will serve as a watch by day

Contained in an old cigarette case the device is also a handy flashlight Photo below shows the case open



MIDGET ELECTRIC ALARM IS KEPT UNDER PILLOW

By R. L. WHITMAN

WHENEVER two or more persons who must get up at different hours sleep within hearing of the same alarm clock, it is likely to awaken the wrong one. The individual alarm illustrated, however, sets up a rousing buzz under one sleeper's pillow, but cannot be heard by anybody else. Being less than ⅝" thick, it causes no discomfort to the sleeper. An added feature is a small bulb that makes the unit a handy flashlight.

A dollar watch with an unbreakable plastic crystal is the timekeeping unit. The cigarette case should be just thick enough to accommodate the watch and two AA-type dry cells such as are used for vest-pocket flashlights. A midget buzzer can be purchased or made from a standard one. How the parts are arranged is shown in one of the photographs. The lid of the case has a hole cut in it to expose the watch face. The back cover of the watch is riveted to the cigarette case.

Remove the watch crystal and the hands. Cut a disk of thin (.005") celluloid ⅛" smaller in diameter than the watch face. Drill a hole in the center of this slightly larger than the hour-hand shaft, and close to the edge drill a ⅛" hole.

Scrape the enamel off the watch face all around on the radius of this hole, exposing the metal. Slip the celluloid disk over the shafts, put back the hour hand, and cement it to the disk so that the latter will turn with it.

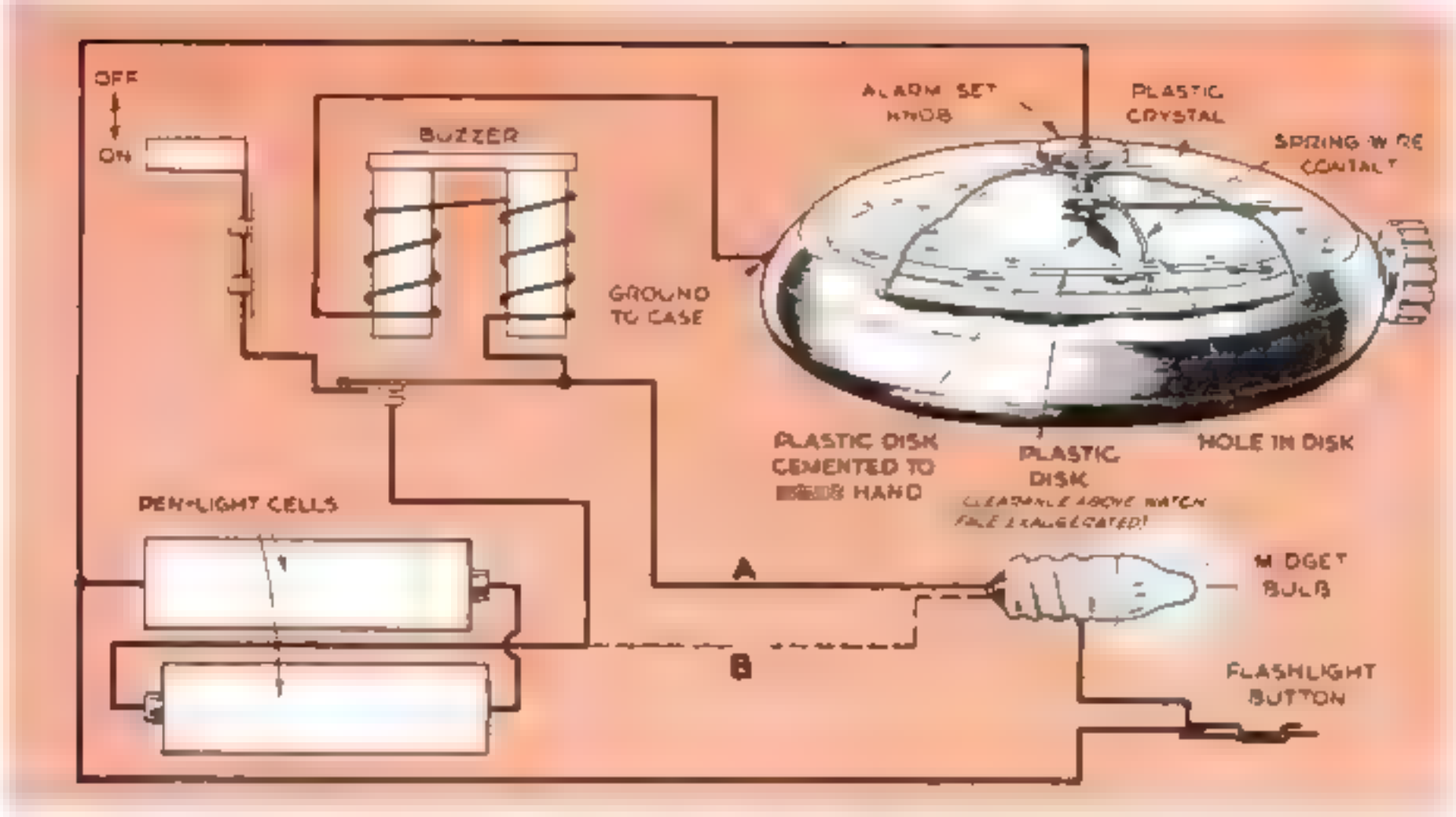


Diagram shows how the lamp bulb may be wired so that it will not light unless the alarm is set for "on"

The crystal must be drilled at the center for the alarm-set shaft, which may be a screw or rivet and carries a knob at the top. This can be made from plastic rod or the cap of a toothpaste tube. Mount the shaft with a spring washer or two so that it can be turned only against friction, and run a metal strap from the upper washer for connection to the battery. To the inside end of the shaft solder the spring-wire contact. Bend its end into a tiny loop so that it will "ride" out of the hole in the disk readily when you have to reset the alarm.

In the original, a cord was run from the buzzer armature to a friction lever projecting from one side of the case. The lever holds the armature away from its contact when the alarm is to be "off." A switch could be used instead. The diagram shows how the lamp bulb can be wired so that it will not light unless the alarm is set "on." If this reminder is not wanted, replace connection *A* in the diagram with connection *B* as shown by the dotted line.

FINISHING PLYWOOD [*PAINTING*]

Natural. Apply priming coat of thin shellac, sand lightly, and rub down with one or two coats of wax. A more elaborate finish may be obtained by using a shellac priming coat followed by several coats of rubbed varnish or lacquer. For outdoor plywood, give several applications of linseed oil or three coats of good spar varnish, the first thinned fifty percent with genuine turpentine.

Paint. For fir plywood use a priming coat of clear resin sealer on both faces and all edges; then apply paint. For hardwood plywood, use a good lead-and-oil base paint. For outdoor plywood, apply clear resin sealer to both sides and all edges; then use best quality paint. In the case of boats, apply at least two coats of marine paint, followed by a coat of spar varnish.

JOINT FILLERS

Interior. Mix white building plaster and shellac to consistency of putty. Force into joint with knife, leaving slight bulge. Sand smooth when dry

Exterior. Brush down edges of joint with slow-drying varnish, and apply any good caulking compound.

POPULAR SCIENCE MONTHLY SHOP DATA

Liquid wax preserves the sheen of kitchen f'nware that is not used on a stove, and protects it from rust

Applied with a cloth-covered block of wood, the wax keeps window screens looking like new

Wallpaper, card-table tops, and window shades can be waterproofed for cleaning with a damp cloth

Waxing enameled handles of kitchen knives prevents unsightly 'checking and cracking through frequent washing—defects like those on the knife at the right

Photographic prints and enlargements coated with self-polishing wax stand constant handling and will not curl. Use a pipe cleaner to apply the liquid

Bristles of a new brush of soaked in liquid wax before being put in service, will remain stiff much longer when used constantly in water

YOU can help conserve the national stockpile of civilian goods by making all normally replaceable articles last much longer, thereby avoiding the purchase of new goods. An easy way of doing this is to prevent wear, rusting, and corrosion by protecting surfaces wherever possible with a suitable finish.

One of the least expensive and most convenient finishes for general use is the "self-polishing floor wax" found in almost every household. Tests indicate that when this type of wax is spread in a thin film on any surface, it dries into a tough skin that will withstand even the finger-nail test and is proof against a considerable amount of wear. As this type of wax costs so little and is so easy to apply, it is no problem at all to treat any number of articles and to keep their surfaces in good condition almost indefinitely.

Self-polishing wax may be applied with a cloth or a brush. Dipping also can sometimes

Excess wear on the window ledges of an automobile, or on other parts of a car, can be prevented by a thin film of hard drying wax renewed a few times each year

Rustproof coats may be given workshop tools that have no enameled finish

SELF-POLISHING WAX

MAKES MANY ARTICLES LAST LONGER

By Kenneth Murray

be used advantageously in the case of very small articles. A thick coating is not necessary. If thin, it will dry ordinarily in about twenty minutes after application

The protective value of this treatment is especially useful in the kitchen. Tinware not used on a stove need be treated only every two months or so for its shiny surface to be kept in perfect condition. The film of wax is so thin that it is imperceptible. Enameled knife handles that ordinarily check and become unsightly through frequent washing can be kept looking new. The same is true of many other kitchen implements.

Elsewhere in the house, a thin film of wax will preserve the finish of imitation-leather card-table tops, check the tendency of window shades to crack and fray, will give a slight, waterproof sheen to wallpaper and permit it to be cleaned with a damp cloth, and will protect window screens.

Raincoats and other articles of rubberized fabric quickly show wear where they are creased or stitched, but the wax will fill pores of the cloth, prevent entrance of water, and guard against further wear.

Stiff-bristle scrub brushes and other brushes have a tendency to lose their elasticity and become flabby after they have become water soaked or been left in water. If, before being used, they are soaked in self-polishing wax, the treatment will make the bristles more water resistant and the brushes will retain their shape much longer.

In the workshop the liquid may be applied directly to tools that have no enameled finish, and will fill the pores of the metal so that it retains its new appearance and does not darken.

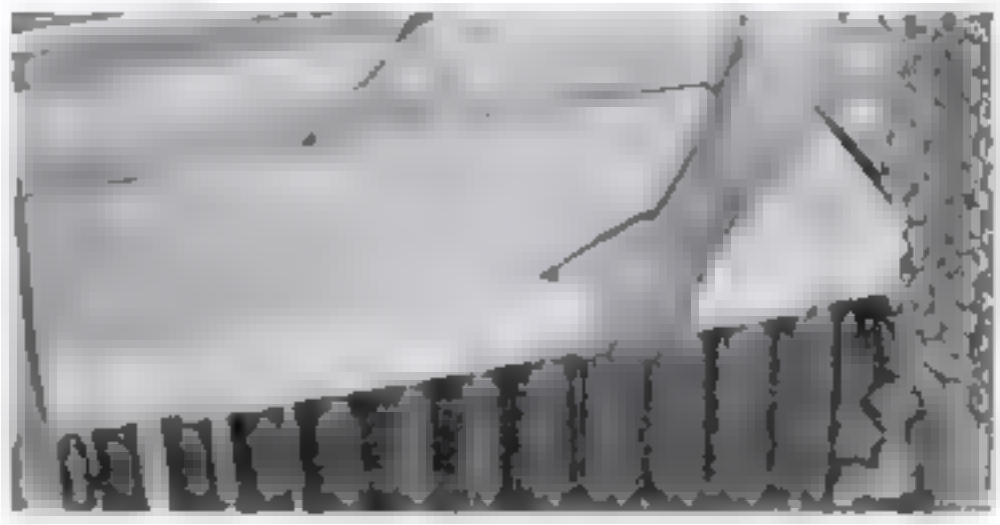
The wax is excellent as a protective finish for a camera, whether of metal or leather covered. Incidentally, it may also be used to waterproof and preserve prints.

Many parts of an automobile receive both wear and weathering so that the finish soon deteriorates. As an example, the window ledges of the car doors often have the finish worn down to the undercoat or even to the bare metal. Self-polishing wax will prevent this condition, and the treatment requires only a few moments several times a season.

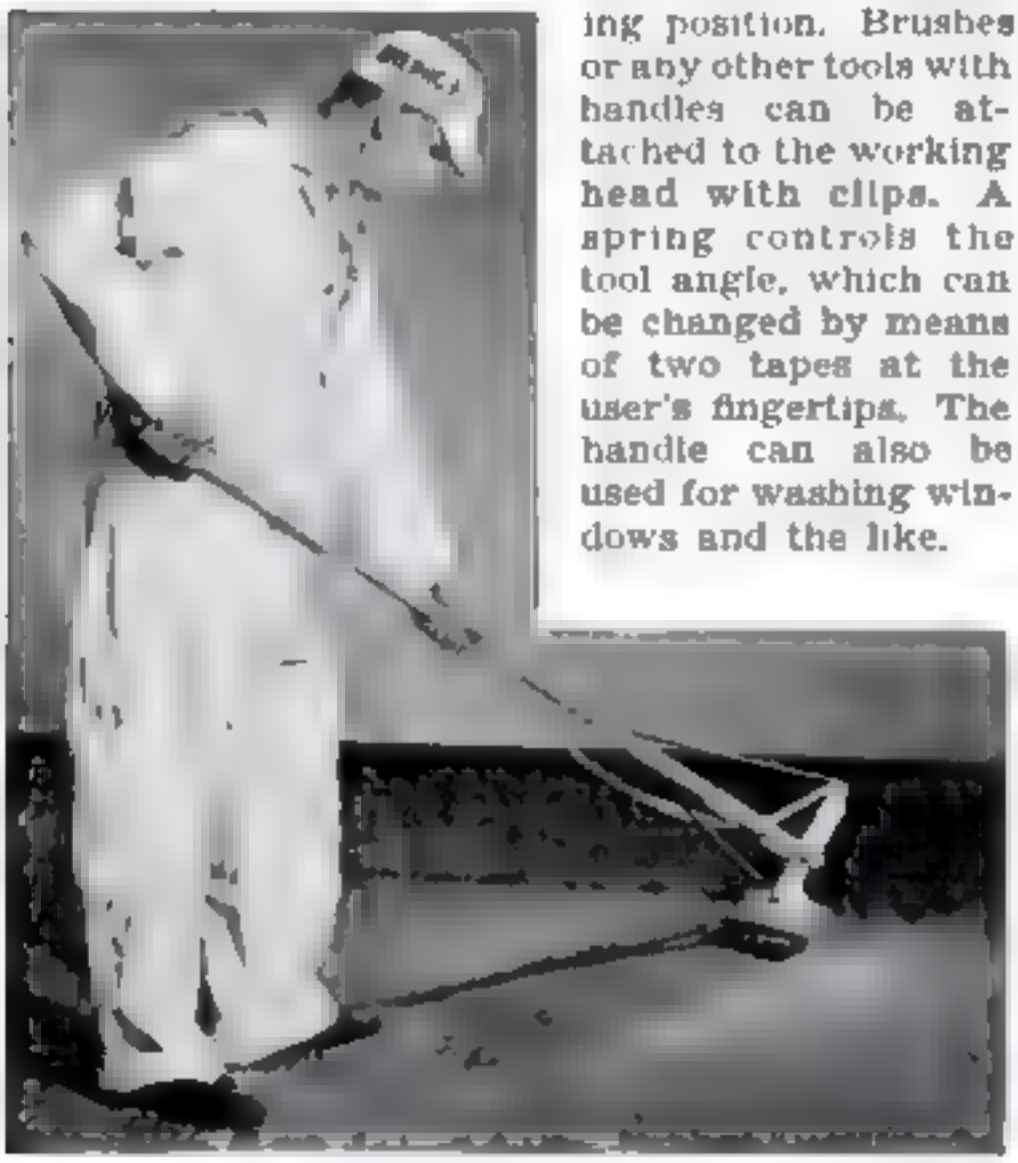
IDEAS for HOME OWNERS

SHATTERPROOFING BLACKOUT PAINT not only keeps light from showing through windows, but reduces the danger of flying glass during air raids. The coated glass will break on impact or concussion, but the fragments cling to the paint instead of flying in all directions. Another blackout paint offered is applied to the outside surface of the glass and dries in one hour, but can be removed with kerosene at any time. Rain will not wash it off.

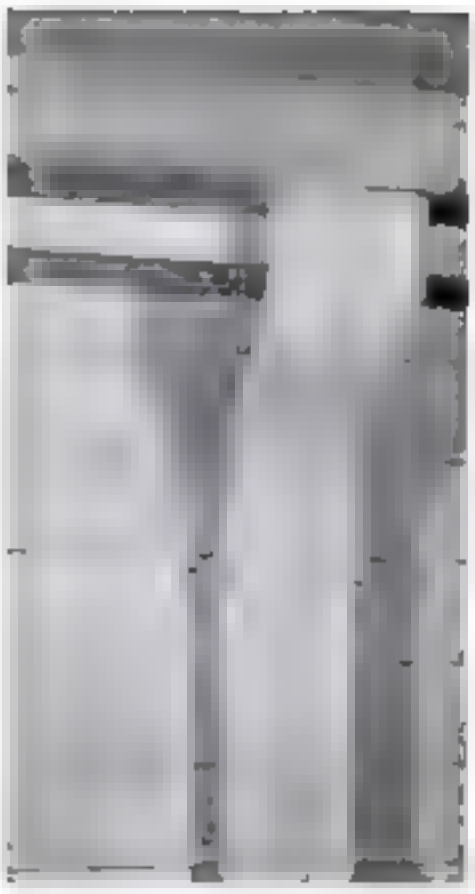
NONPRIORITY RADIATOR COVERS, made of wood instead of metal, are now available in nine adjustable sizes ranging from 14" to 76" in length and from 8" to 12" in width, and in several colors, including ivory and walnut. Both ends of the covers slide in or out for adjustment of length, so the raised portion remains in the center, rather than at one end, giving the cover a much neater appearance.



THIS BRUSH EXTENSION HANDLE permits the operator to paint walls, ceilings, high moldings, baseboards, floors, and the undersurfaces of shelves and the like from a normal standing position. Brushes or any other tools with handles can be attached to the working head with clips. A spring controls the tool angle, which can be changed by means of two tapes at the user's fingertips. The handle can also be used for washing windows and the like.

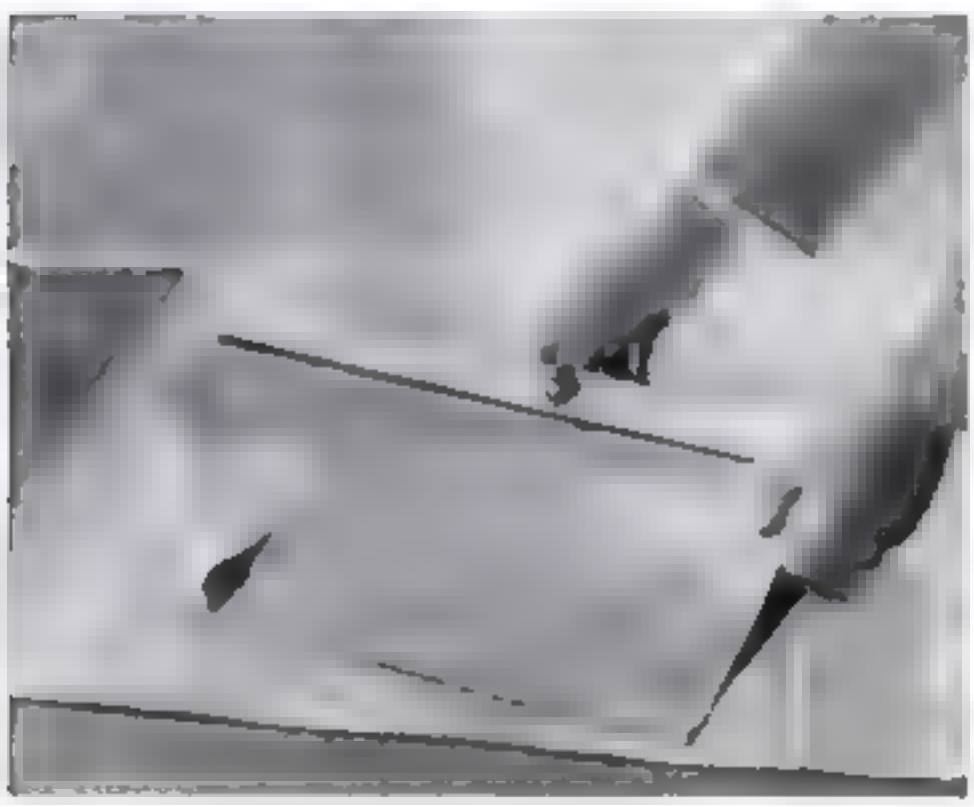


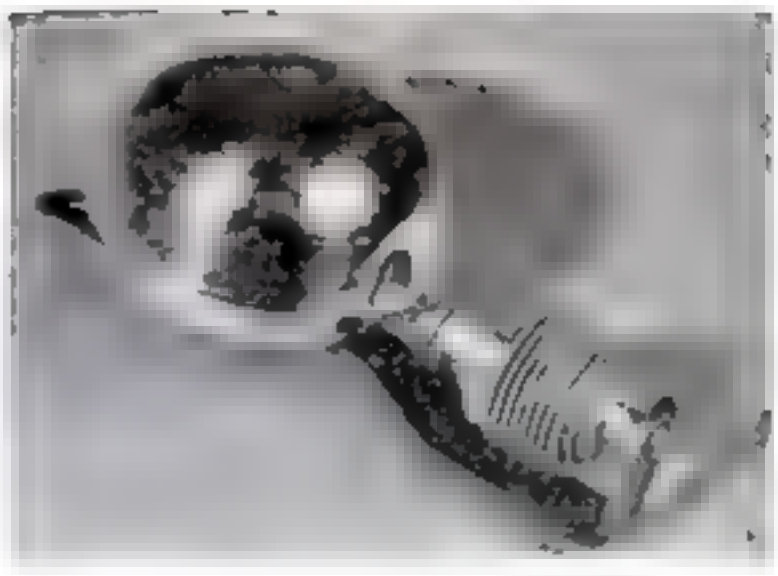
FIBER CONCRETE FORMS, resembling giant mailing tubes, speed the setting up of concrete piers or posts for foundations, and save the time and material formerly required to put up and take down wooden forms. After the concrete has been poured into them and has set, the forms can be cut away or simply allowed to disintegrate. Sizes from 6" to 13½" in diameter are available, and lengths are up to 24'.



WOODEN DOWN SPOUTS, ELBOWS, AND EXTENSIONS are being developed to replace rapidly vanishing metal ones. It is planned to make the units adjustable so that the down spouts may be adapted to any type of cornice, and to provide sufficient flexibility to take up expansion in case of freezing. Wooden ventilators for farm buildings (not illustrated) have been designed in three sizes, any of which can be made from standard lumber. Louvers produce a swirling motion of the air that aids exhaust action.

CANVAS WALL COVERING that is washable and is said to reinforce plaster against cracking is now available in harmonizing companion patterns for the decoration of adjoining rooms. Its designs consist of oil paints printed on a canvas foundation, affording a nonporous and nonabsorbent finish. The material is 48" wide and is sold by the yard. It can be repainted at any time.





AN AUTOMATIC FIRE ALARM that requires no batteries or wiring is wound up like a clock. If the temperature at any time rises to 110 deg. F., an expanding thermostat presses a release button, and the spring-operated bell rings. The thermostats are also available mounted on insulating plates with two electrical terminals each for connection to the existing doorbell circuit. They ring the bell continuously should fire break out. Any desired number can be used in parallel.

PUTTY MADE FROM WOOD comes in powder form and is mixed with water for use. When hard, it can be sawed, chiseled, nailed, sanded, or polished like wood. Filling cracks, knotholes and nail holes, covering tile and insulating-board joints, and setting loose handles are a few of its uses. It adheres to wood, cement, plaster, stone, and wall board, and dry color may be added to tint it. It can also be molded into novelties.

Other new ideas:

ASBESTOS AIR-CONDITIONING DUCTS, entirely prefabricated, save steel and labor. They are made with slip joints for easy installation.

A BLACKOUT BULB that can be left on even near open windows gives a faint orange light. As yet it is restricted to industrial plants.

PAINT MADE FROM CORN, now available in powder form, is mixed with water for use. It is said to be more washable than casein paint.

NONDRYING ADHESIVE applied to blackout paper holds it firmly to window glass, yet allows it to be pulled off readily at any time.

ROLL-TYPE GARAGE DOORS that coil up overhead on a barrel like a window shade are now made of wood slats fastened to metal tapes.

RECLAIMING Hack-Saw

NEW hand back-saw blades tend to break close to the pin when too much pressure is applied. To conserve vital steel, these blades should be salvaged.

The first step is to round off the broken end to the original curvature. Care should be taken to hold the blade vertically against the grinding wheel, since if it lies flat on the rest it may snag and break again or gouge a hole in the wheel.

Next, drill a 5/32" hole about ¼" deep in a block of scrap iron. Place the blade on this block with its end centered over the hole, and hold a 5/32" punch on the blade directly over the hole. Strike a square, sharp blow on the punch with a medium-sized hammer to make a clean round hole for the holding pin in the saw frame. After the hole is punched, the saw frame will, of course, have to be adjusted to accommodate the shorter blade.

Broken power-saw blades, too, can be rescued from the scrap heap and made serviceable by brazing or silver soldering. Most power hack saws don't have an adjustable stroke, and all the wear comes on about one half of the blade. If you take the good ends of two broken blades, silver-solder them together, and punch another hole, you will have a blade that's almost as good as new.

Before brazing or soldering power-saw blades, the broken ends must be squared up. This type of blade is thick enough to be ground lying flat on the grinding rest without snagging the wheel. Next, the ends are beveled. Experience has shown that a beveled surface one and a half times as wide as the blade is thick does the trick. The bevels should be ground so that they fit together without humps or hollows. However, the teeth don't have to match up as they must in brazing a band saw.

The parts may be brazed or silver-soldered. In either case common grocery-

It's often a brand-new blade that breaks, but if the break is close to the pin, the blade can be saved and, though shorter, will give good service

First step, below, is grinding the end. Hold the blade on edge, not flat. Right, punching the hole

Blades

Left above, halves of a power blade beveled for brazing. The white powder is borax. Bronze filings or a strip of silver solder is used as brazing metal. Both are shown

Above, a small acetylene or propane flame is directed against the seam only until the solder or filings melt

store borax is used as a flux. If bronze filings are used, line the blade up with the beveled edges in position, place a pinch of filings along the seam, and over them sprinkle a light coating of borax. For silver-soldering, cut a strip of solder about twice the area of the beveled edges, pull it through your fingers to remove any wrinkles, moisten it, and sprinkle both sides with borax. Then place the strip between the beveled edges and sprinkle a light coat of borax along the seam.

Heat is then applied to complete the braze. A small lead-burning tip, using either actylene or propane gas, is ideal for this operation. The flame is directed along the seam and removed the moment the filings or solder begins to flow.

If allowed to cool naturally at room temperature, the blade will lose little or none of its hardness. Don't quench it in water. Punching the end hole can be simplified by heating the end of the blade a light red and punching while hot.

After cooling, the seam can be very lightly ground for a total width of ¼" on both sides of the blade. This will remove any roughness, especially if the clearance is carried right across the surface of the blade, including the teeth.

It may not be profitable to repair blades singly, but if they are repaired in batches of ten or more, a real profit may be made and, even more important, some valuable alloy steel will be saved as a contribution to the war effort.—W. C. CHENEY.

SLOPE PER FOOT IN DEGREES [CALCULATIONS]

Protractors, adjustable triangles, and quadrants of shop machines are graduated in degrees, but blueprints often express an angle as so many inches or fractions of an inch of slope per foot. Such specifications can be converted to degrees by calculation or reference to tables. The one at the right gives degree equivalents of the angles most commonly specified. Much time can be saved by cementing such a table to the protractor, triangle, or machine.

INCHES PER FOOT	EQUIVALENT ANGLE	
¼"	1°	12′
⅜"	1°	47′
½"	2°	23′
⅝"	3°	—
¾"	3°	35′
⅞"	4°	11′
1"	4°	46′
2"	9°	32′
3"	14°	15′
4"	18°	55′
5"	23°	32′
6"	27°	—

POPULAR SCIENCE MONTHLY SHOP DATA

DRILL-PRESS JACKSHAFT
GIVES WIDE RANGE OF SPINDLE SPEEDS

ALL that has to be purchased for this jackshaft is a 4-step pulley, one 25" V-belt, and one 28" V-belt.

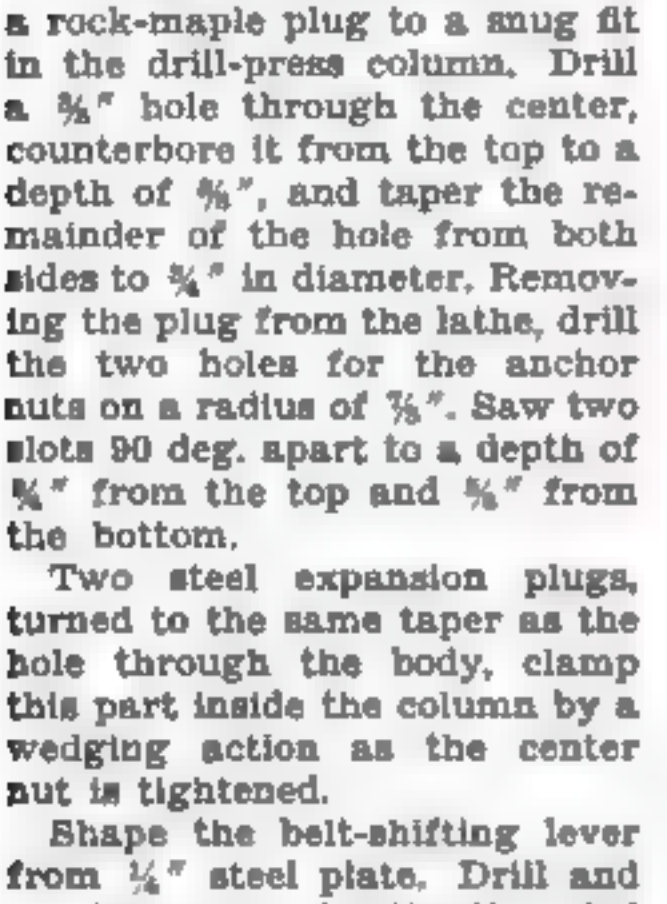
For the jackshaft itself, turn a rock-maple plug to a snug fit in the drill-press column. Drill a ⅜" hole through the center, counterbore it from the top to a depth of ⅝", and taper the remainder of the hole from both sides to ¾" in diameter. Removing the plug from the lathe, drill the two holes for the anchor nuts on a radius of ⅞". Saw two slots 90 deg. apart to a depth of ¼" from the top and ⅝" from the bottom.

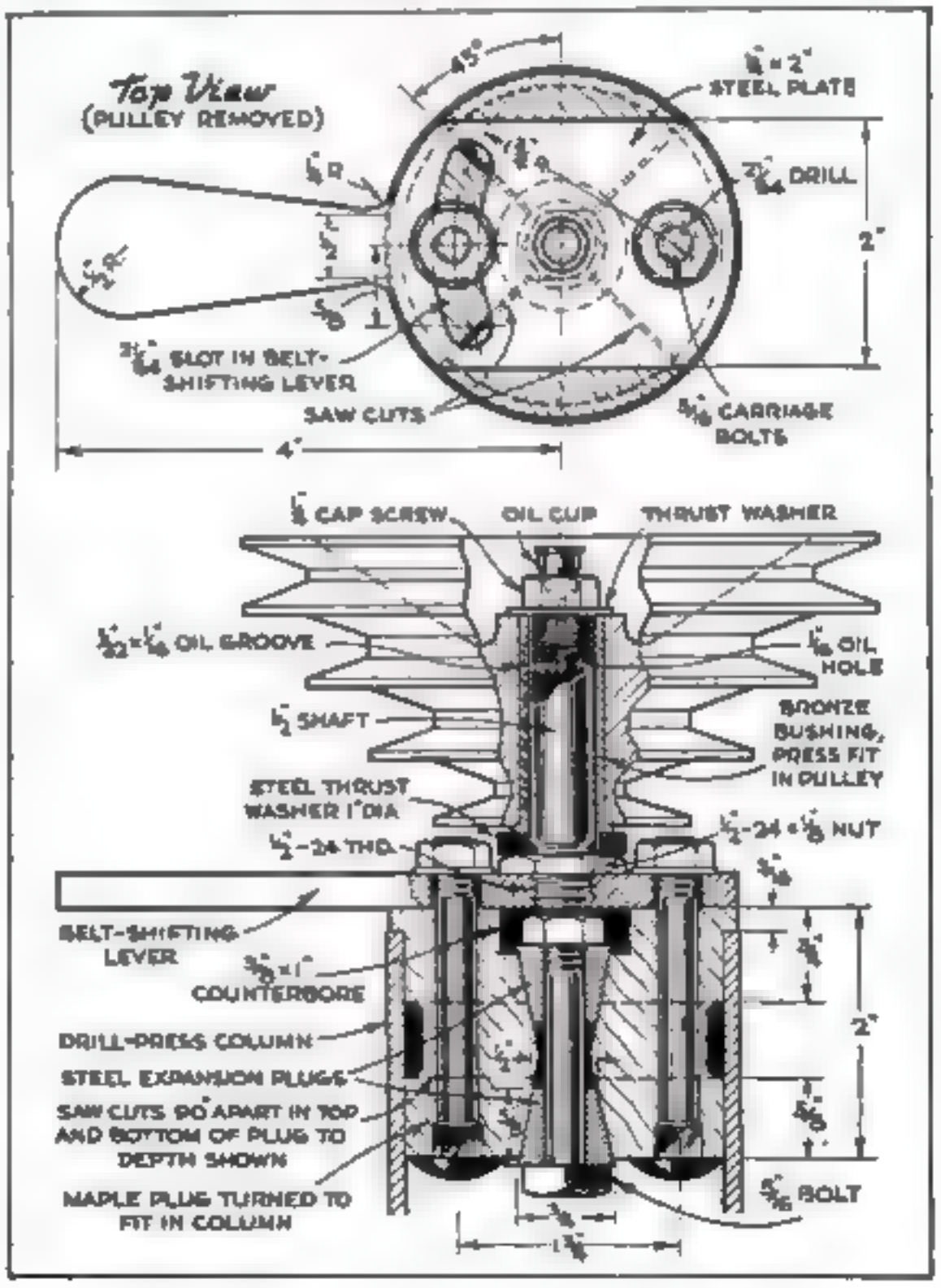
Two steel expansion plugs, turned to the same taper as the hole through the body, clamp this part inside the column by a wedging action as the center nut is tightened.

Shape the belt-shifting lever from ¼" steel plate. Drill and tap the center for the threaded pulley shaft as indicated. The curved slot has a radius of 1¾" and is laid out from the pivot hole, not from the center.

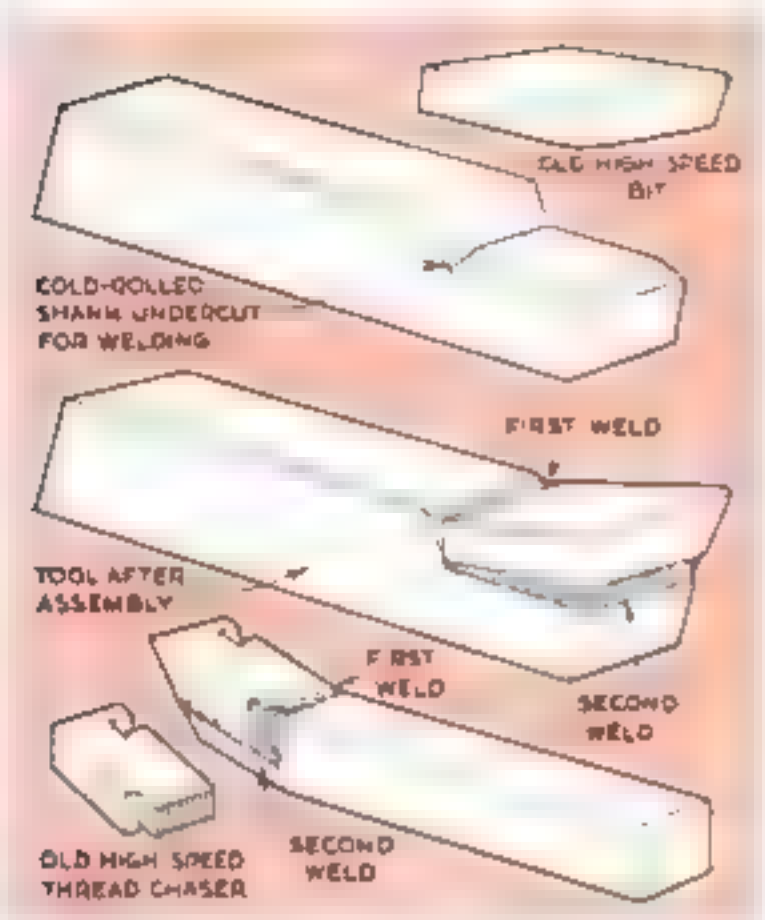
Thread one end of a piece of ½" shafting to fit the tapped hole in the lever. Tap the other end for a ¼" cap screw. The pulley is fitted with a bronze bushing. Assemble with thrust washers as indicated.—C. W. BATTELS.

Jackshaft (arrow) offers choice of speeds from 260 to 10,000 r.p.m. and greatly increases the scope of any drill press for light and heavy drilling, routing, shaping, and milling. It is easy to make and, if necessary, can be built almost entirely from scrap stock





Old High-Speed Bits Salvaged by Welding to New Shanks

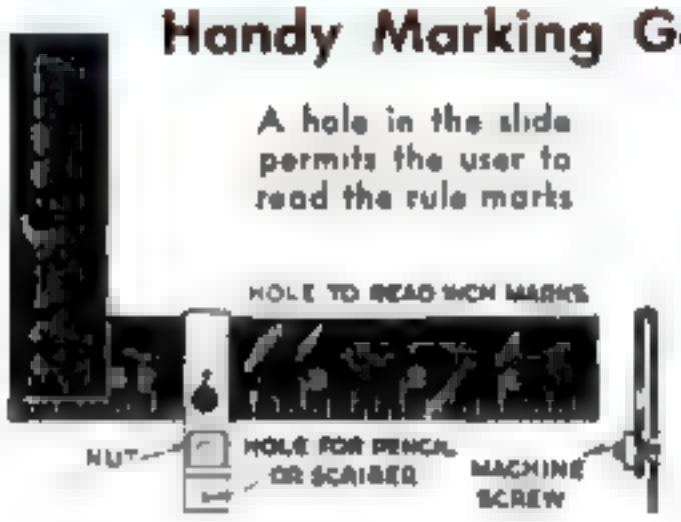


A NEW life of usefulness can be given old high-speed bits and thread chasers that have been ground short simply by welding them to cold-rolled steel shanks. Such welded bits give good service as form, boring, and turning tools in machining aluminum alloy, stainless steel, drill rod, and even tool steel.

As reported in "War Production News," organ of the WPB for New York State and northern New Jersey, the high-speed steel first tended to crack during the welding process. This was overcome by welding the fragment first at the heel, heating and quenching it, then welding it at the base and again heating and quenching, as shown in the accompanying drawing. Apparently the heat had no bad effect on the properties of the high-speed steel.

With this method, various special tools can be made up on short notice. The cold-rolled shanks can be used indefinitely, as other tool bits are easily welded on when the old ones are ground down too much for further use.

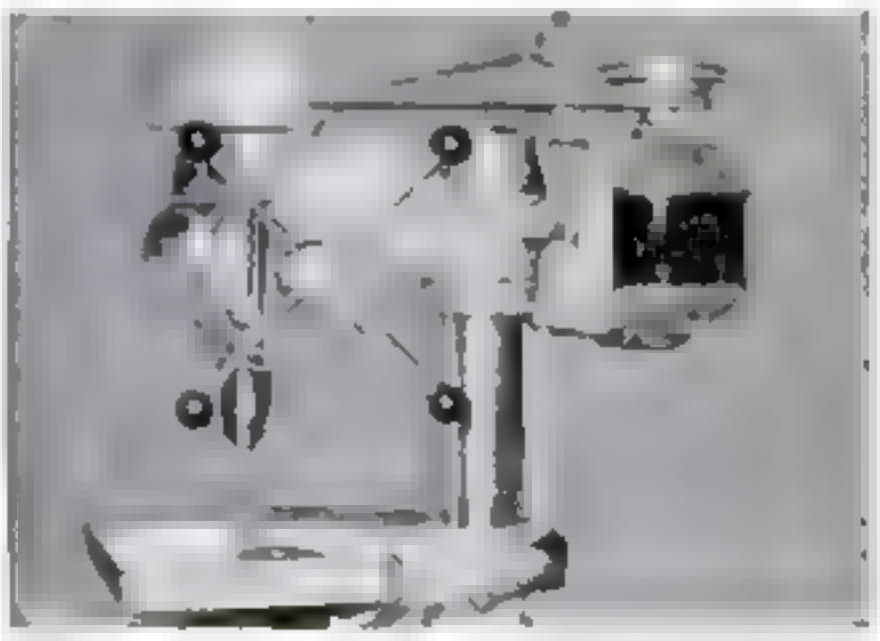
Handy Marking Gauge Is Easily Attached to Try Square

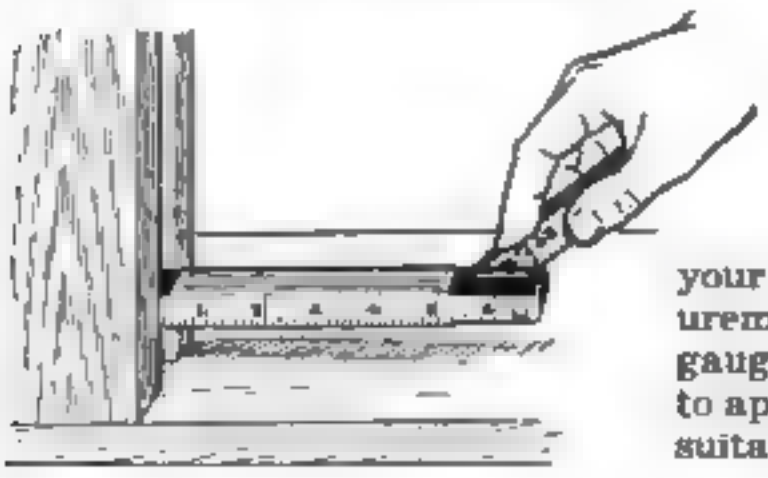


A MARKING-GAUGE attachment to fit your try square can be made from a piece of 1 16" by ½" band iron and a machine screw. Bend the band iron in a U shape, as shown, with one leg ½" longer than the other. Drill a ¼" hole through the shorter leg to line up with the markings on the square, and a 1/16" hole near the end of the long leg into which the marking pencil can be inserted. The slide can then be tightly locked at any desired setting for scribing lines parallel to the edge of a board.—RONALD EYRICH.

Sash Lift Aids in Balancing Weight of Drill-Press Table

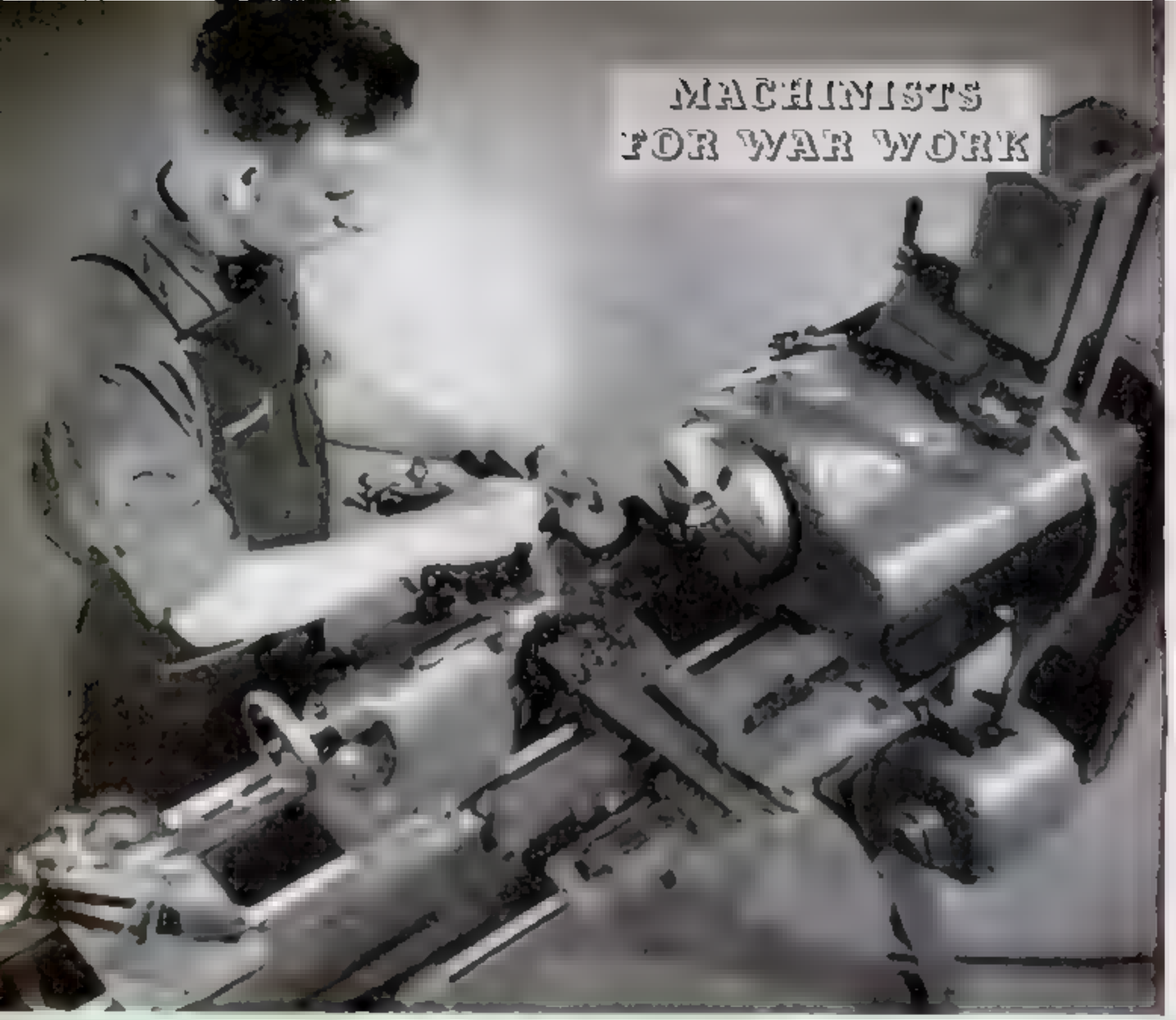
TO COUNTERBALANCE the weight of my drill-press table, I obtained through a local hardware store a spring-type sash lift of from 27 to 29 lbs. capacity. I fastened the spring housing to the back of the motor, and the tape to the rear of the table. In this way the weight is exactly counterbalanced, and there is no danger that the table will slip down the column accidentally when the lock is released.—DAN D. FULMER.





Folding Rule Used to Pinch-Hit as Rough Thickness Gauge

NEXT time you are about to search through your scrap box for a strip of wood to fit a certain measurement, try using a common folding rule as a thickness gauge. Simply fold up the number of rule sections needed to approximate the dimension and then compare this with suitable strips as you find them.



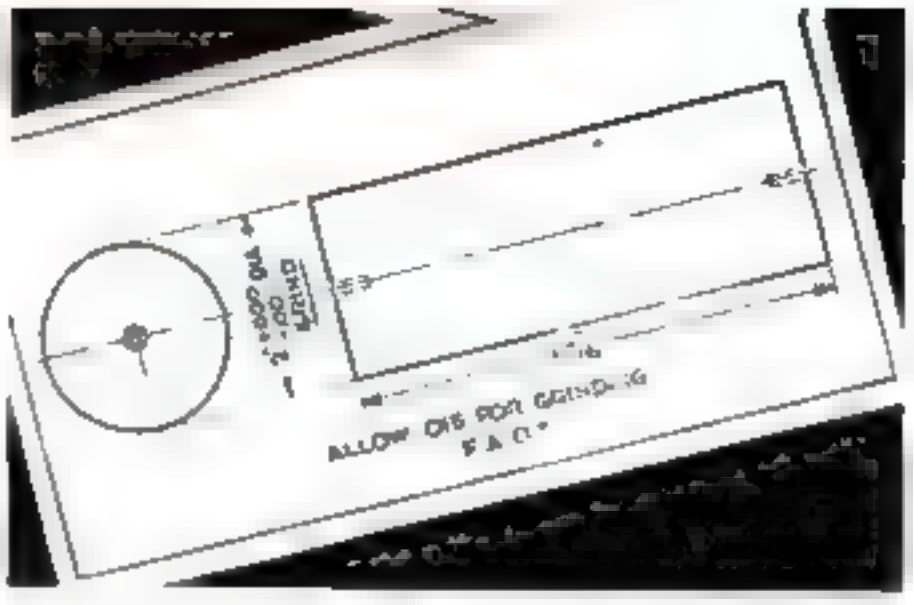
ROUGH TURNING

"Learn more to earn more" is a good slogan these busy days. Whether you're preparing for defense work or already in it, your advancement will depend on what you know. To train war workers in the fundamentals of machine-shop practice, the U. S. Office of Education has prepared a series of 16-mm. sound films, one of which provided the material for the following article. These motion pictures, distributed for the Government by Castle Films, are of inestimable value to the shop student and beginner. Don't fail to see them if they are being shown in your community or at your plant.

ANYBODY who wants to qualify as an all-around machinist must be able to do good lathe work. There is probably no machine tool in the shop that comes into use more often or is capable of as many operations. In its many variations, including the automatic screw machine and turret lathe it is indispensable to mass production.

The student machinist should be familiar with the parts of a back-geared screw-cutting lathe, and can learn them from diagrams in shop handbooks and manufacturers' catalogs. The machine shown above is a modern quick-change lathe, on which the spindle and carriage-feed speeds can be changed by setting certain levers, much as gears are shifted in an automobile. On simpler lathes, these changes are made by mounting different gears between the

1 Our job is to rough-turn from steel stock the pin that is here shown being inserted in the rear-axle assembly of a United States Army truck. After turning, it will be ground to precision fit



2 This drawing tells the operator the shape and size of the completed job. Note that the pin is to be 2" in diameter when finished, but that .015" must be allowed for the grinding operation

3 After being checked for size, stock is cut to length and centerdrilled. The machinist then will peel off the surface to the diameter on the drawing, plus the required allowance for grinding

4 Now the operator prepares the lathe for use. Chips and abrasive grit are brushed from the ways, carriage, and lead screw. Next, the machine is oiled carefully, no oil holes being overlooked

IN THE LATHE

spindle and the lead screw, but the principle remains the same.

A good lathe operator is expected to turn out a job without injury to himself, the lathe, or the work. Machines have no intelligence, and the worker's safety depends entirely upon taking proper precautions at all times. Note, for example, the haircut of the operator shown on the facing page. Has it anything to do with operating a lathe safely? Certainly. A man working over a machine *must not have unruly hair.* Flowing neckties are taboo also. Sleeves must be rolled up, the collar buttoned. The floor around the lathe must be clear so that there will be no danger of stumbling near the machine.

To prevent damage to the lathe itself, the operator must first of all make sure it is clean. Chips and dirt on the ways, dovetail slides, and other parts cause excessive wear and inaccurate work. A good operator will use a brush to clear coarse chips off the machine, following with a cloth to remove finer ones and dust. Chips are sharp and should never be brushed off with the fingers.

Lathes are costly, and no good machinist will operate one without making certain that it is properly lubricated at every point. If unfamiliar with a lathe, inspect it carefully to find *all* the oil cups, or check the location of them on the maker's chart.

Rough turning is a comparatively simple lathe operation, but one that demonstrates well a number of the principles involved in all lathe work. The accompanying photographs follow through a typical rough-turning job step by step.

5 The tapered center holes must be absolutely clean, for even a tiny chip will throw them off center. Never push a cloth with the fingers into the live-spindle hole while it is turning

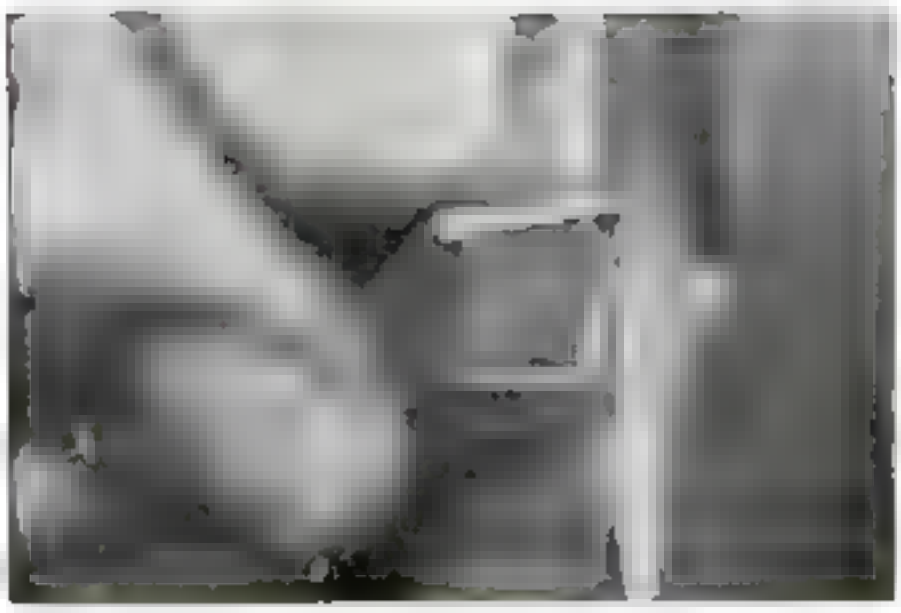
6 The threads on spindle nose and dogplate are cleaned and oiled. Then, fit the plate on the spindle and turn backward till the threads slip by each other. Now screw the dogplate on by hand

7 Clean each center with care, oil it lightly, wipe and place in the spindle hole. Be sure that the tail center is a hardened one. It will often have an identifying groove back of the point

8 The tailstock or dead-center hole should be lubricated with oil or white lead. A driving dog of suitable size is then placed over the live-center or opposite end of the piece to be turned

9 Hold the work with the dog on live center, bringing dead center into position to enter oiled hole. Dog tail fits loosely into dogplate driving slot. Lock tail spindle and tighten dog

10 This tool bit has been ground to do rough turning. The nose angle is 5 deg., with 10-deg. heel clearance and 8-deg. side clearance. A top rake angle of 12 deg. is ground as well



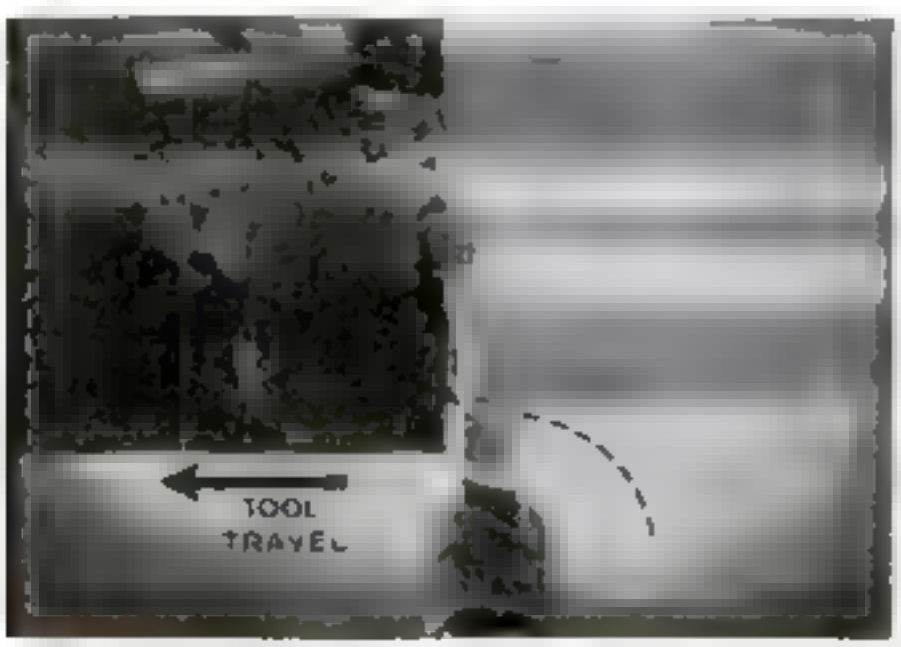
11 The roughing tool turns tough steel or hard cast iron. It touches the work only at its cutting edge. After grinding, the bit is dressed with a fine oilstone for long life and smooth cut

12 Standard tool holders keep the tool bit at an angle of from 15 to 20 deg. This tool is inserted until only a short portion of the cutting end projects, and the clamping screw is tightened

13 Fix tool holder in the tool post and tighten screw. Swing compound rest away from cross-feed handle. Then set the cutting edge of this tool square with work and slightly above center

14 For safe operation there should be as little overhang as possible in the tool bit and the holder (arrows above). Check both of the clamping screws for tightness when the tool is in position

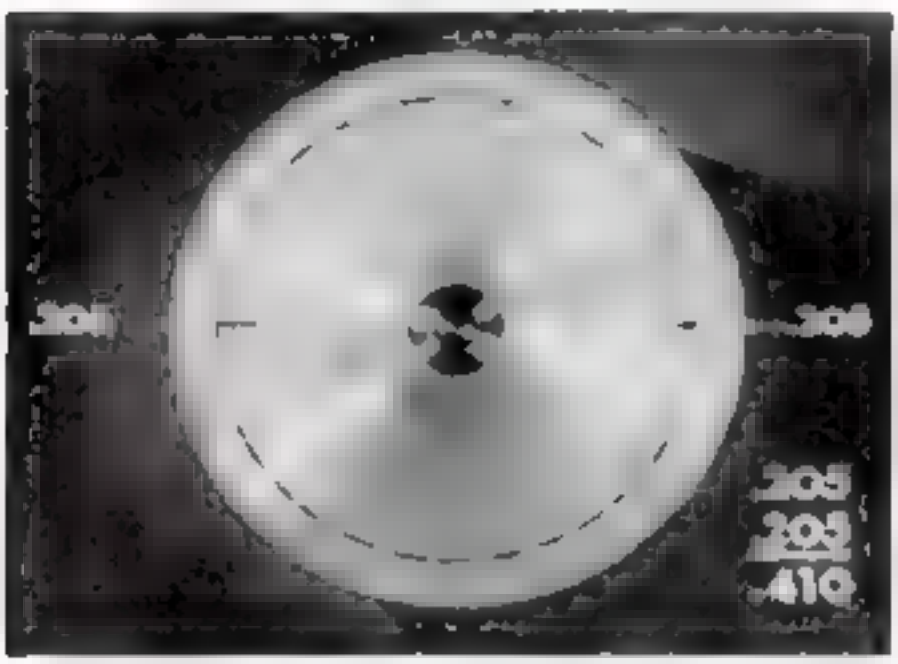
15 Should tool holder twist loose, it would be away from work along dotted line, causing no damage. However, were contact point ahead of the right-angle line, the tool might dig, spoiling work



16 Using cross-feed screw, set tool for shallow trial cut. Adjust spindle and feed speed as required. Turn spindle by hand to make sure all is free and that dead center is not set too tight

17 Switch power on and engage carriage clutch. Watch trial cut closely, but keep your eyes and hands away from dangerous flying chips. Allow trial cut to proceed only ¼"; then stop lathe

18 With 3" micrometer, check diameter of trial cut, giving above reading, or 2.425". If it were cut with the cross feed as now set, the work would be .410" over required diameter of 2.015"



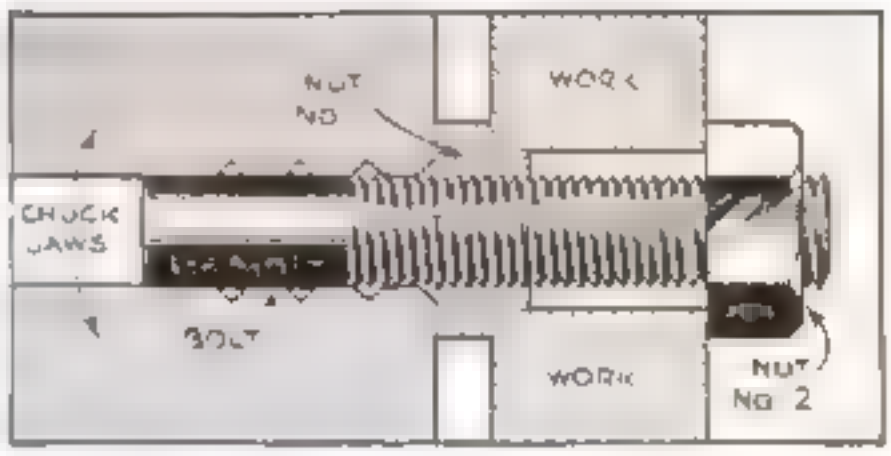
19 As above diagram shows, the cross slide must be set to cut off a half of .410", or .205". Note that the amount of metal removed is double the depth of cut, since the stock is cylindrical

20 Proceed with second trial cut for ¼", then stop lathe and again check diameter. Reading now is 2.016", or .001" more than required, but this much oversize is allowable in rough turning

21 Check tail-center adjustment, continuing cut. Carry it to safe distance from whirling dog, as shown below; then stop lathe, bring back carriage, remove the work, and clamp dog to the finished end

22 After oiling the other center hole, mount the work once more between centers. Using same cross-feed setting, make second cut till it meets the first. "Mike" as below, and check with print

Bolt and Nuts Form Arbor for Machining Small Work

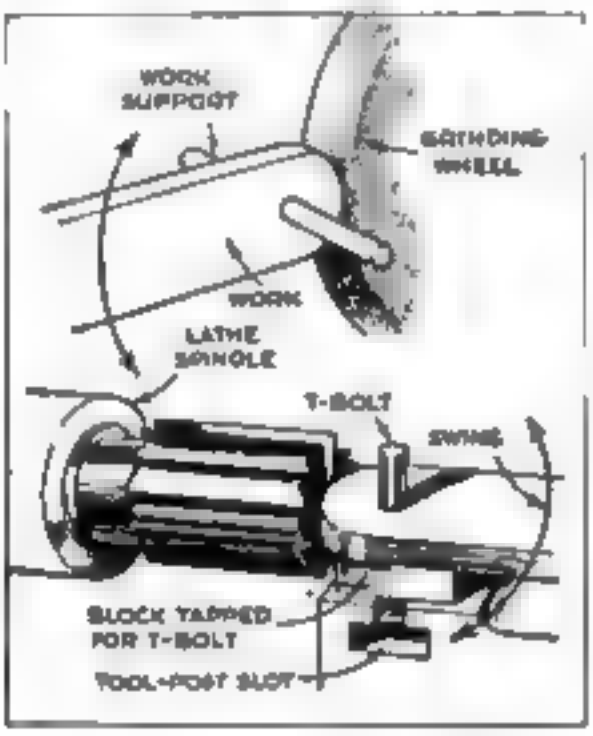


IF A MANDREL of the proper size is not available, a small gear blank, collar, or similar piece that must be machined all over can be mounted for turning as follows:

Chuck the work, drill it through or otherwise bring the bore to size, and face one side. Cut off the head of a bolt somewhat smaller than the bore and about four times as long. Chuck this bolt and run a nut up tightly against the chuck jaws. Then turn a shoulder on the nut to fit the bore of the work snugly. Use two or more nuts if the bore is deep.

Place the work on this shoulder and hold it with a second nut as shown in the drawing above. For very accurate work, or if the unmachined surface is irregular, use a cardboard or fiber washer under the second nut.

If the small area under this nut must also be faced, this can usually be done with very light cuts after the nut is removed, provided the work is a press fit on the shoulder. The nuts and studs can be saved and used again. All that is necessary is to take a truing cut on the shoulder each time you wish to use this arrangement.—J. S. MORREL.



Simple Tool Setup Forms Radii on Bars and on Corners of Square Work

WHERE a true radius must be formed on the end of a flat bar or at the corner of a square or rectangular piece, it can be done by pivoting the piece on a firmly supported shaft at the required distance from the grinding wheel, as shown at left. Radii can also be milled in the lathe by mounting a T-headed bolt on the compound rest as in the second drawing. Turn a threaded block or collar up on the bolt to clamp it tightly in place.

The hole in the work must be a close fit on the pivot pin. If the hole is objectionable, drill a piece of scrap stock to fit the pivot pin and clamp the work proper tightly to the scrap piece so that both can be swung about together.—C. W. W.

REPAIRING A NOISY MOTOR [ELECTRICAL]

Excessive noise or vibration in a small motor may be due to any of several defects. The most common of these is worn bearings. To check for this condition, grasp the shaft with the fingers and try to move it up and down, taking no note of end play parallel to the shaft. There should be no appreciable up-and-down movement. If there is, new bearings should be installed. The old ones, if of the sleeve or bushing type, are pressed out and new ones obtained from the manufacturer. These may have to be reamed to a fit for the shaft after they have been pressed into place in the end bells. A slight amount of end play is allowed with sleeve bearings, but if it is over 1/16", place fiber washers on one or both ends of the shaft to reduce it. Be sure to test for end play with the frame bolts pulled up tight.

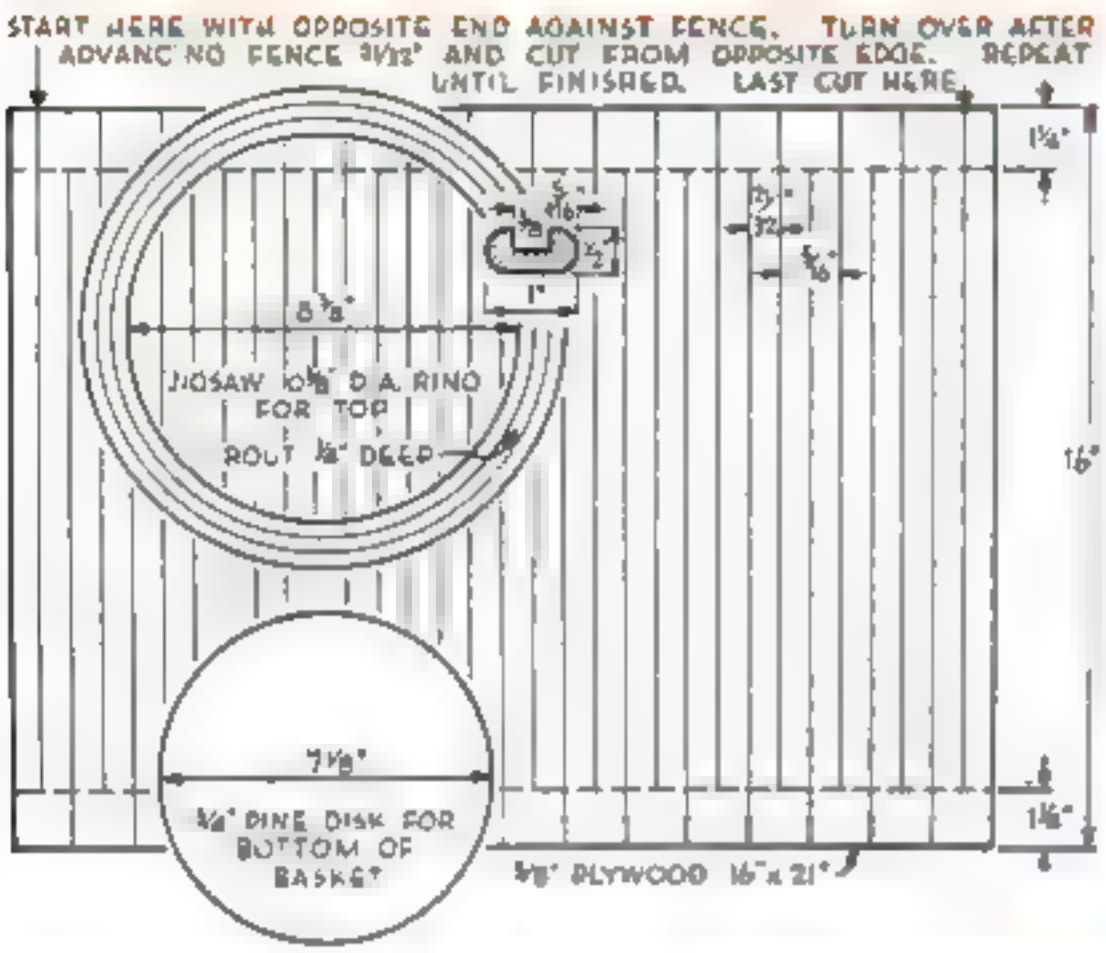
Ball bearings are even easier to install because, of course, they require no reaming. It is necessary only to obtain correct replacements. However, no end play at all should be apparent with ball bearings. These must be packed with medium grease.

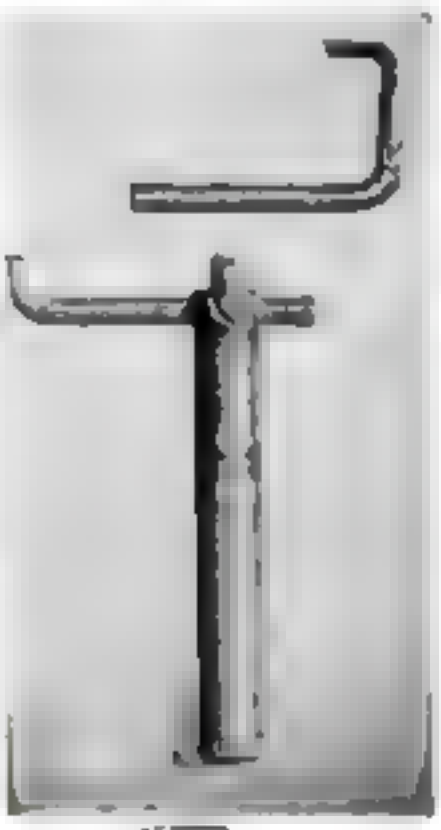
An unbalanced rotor may cause vibration. Remove it and place the shaft across two parallel knife edges mounted perfectly level. When turned, the rotor should not tend to stop in the same position each time. If one part persistently turns to the bottom, drill one or more shallow holes into the core at that point, until the rotor is in perfect balance.

POPULAR SCIENCE MONTHLY SHOP DATA

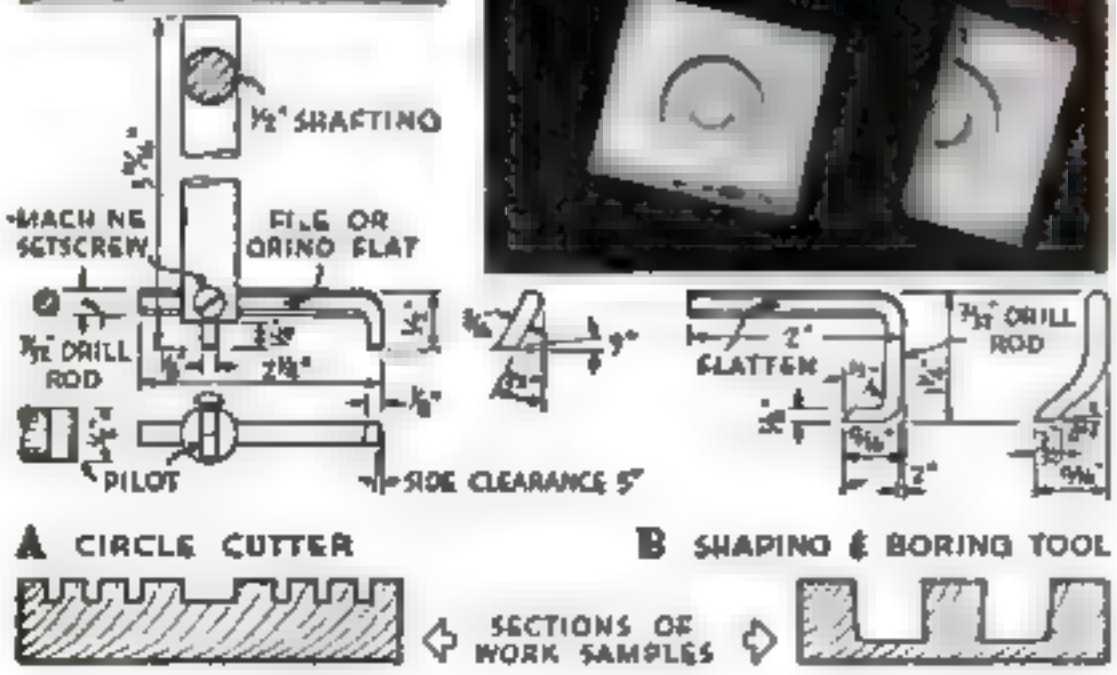
CRAFTWORK FOR

Four Out-of-the-Ordinary





CRAFTSMEN, here's a real winter harvest of unusual things to make—a feast of workshop projects to whet your creative appetite and suit your taste for interesting variety. First is a fine horse-head book end, hand carved and of rich appearance. Then comes an eye-catching wastepaper basket, new in design, novel in execution. Next, you'll welcome a handy little boring bar and circle cutter, plus a shop cabinet for small hardware.



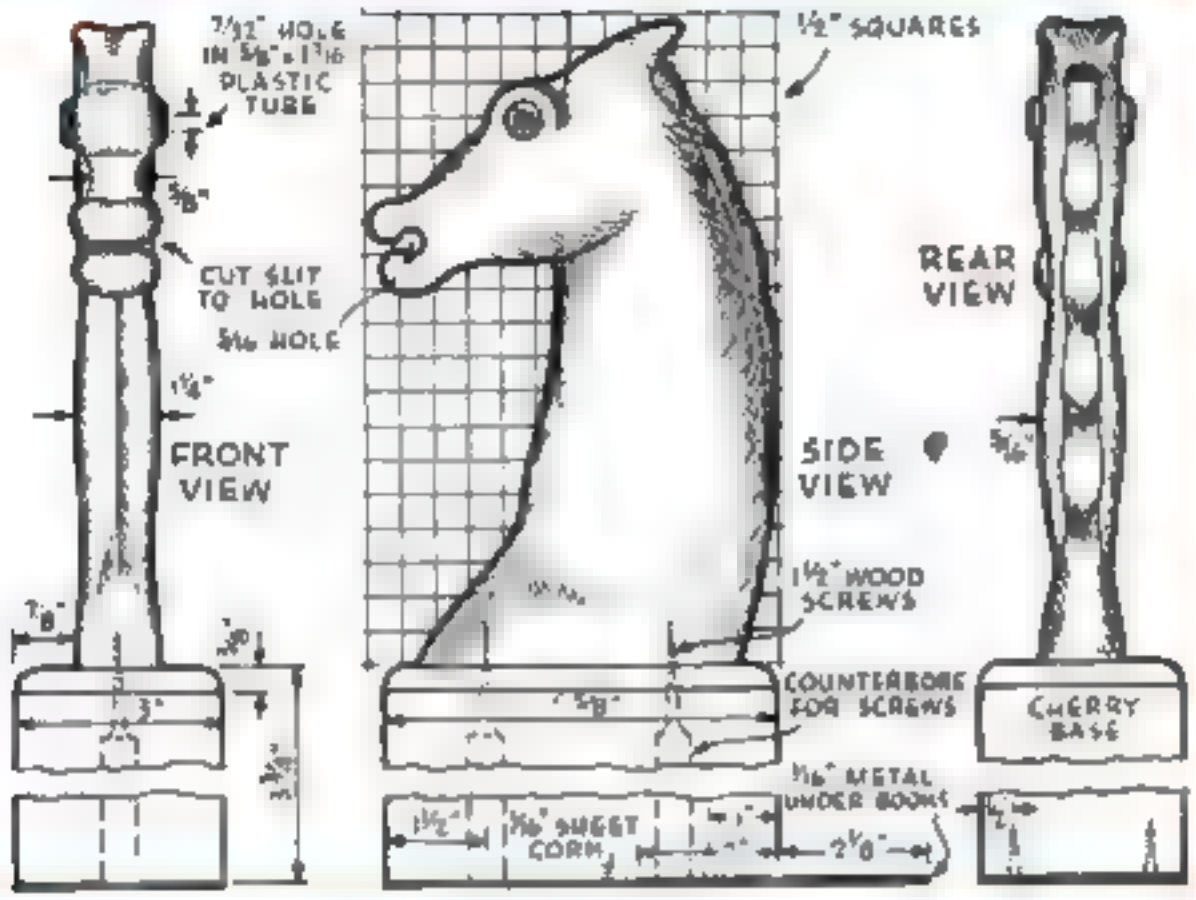
SCULPTURED BOOK END. Any man's library might display this novel "horsy" book end to advantage. Plot the outline on squares, following the contour on the squares in the accompanying drawing. Band-saw it from a selected piece of mahogany 1⅛" by 5⅞" by 9 5/16".

Use a ⅜" gouge for carving, keeping the work padded in the vise against marring. The eye is

WINTER EVENINGS

Projects

DESIGNED BY
ERNEST R. DEWALT



a black plastic tube, ⅜" in diameter and 1 7/16" long, set in a previously drilled hole. The mouth is formed by a 5/16" hole, ⅜" in from the end of the piece, cut into from the front.

A V-gouge is used for the incision that articulates the curve of the mane. Leave a fairly sharp dividing line at the front, as shown. Textural interest is given the back curve of the mane by letting the tool marks show.

Sandpaper the entire piece smoothly, flowing the contours together. The base is heavy to prevent tipping, and is a cherry block, 3" by 3⅜" by 5⅝", rounded at the top and finished very smoothly. Counterbore for two wood screwa to mount the carving. Keep the back of the horse and the rear wall of the base in line for the book to rest against.

A metal or plastic sheet 1/16" by 3" by 4⅛" is screwed to the underside as shown. The entire undersurface of the base is covered with 1/16" sheet cork, cemented on.

Finish: Three coats of clear lacquer rubbed between coats and waxed many times for a dull, rich sheen. Working time, 5½ hours.

"SPREADWOOD" BASKET. Serviceability and modern appeal are combined in this wastebasket, and there will be added zest in working out an interesting project made mostly of a single ⅜" sheet of plywood 16" by 21". The grain of the face ply runs in the direction of the shorter dimension. Make a series of circular-saw cuts from opposite edges 21/32" apart. Cut against the rip fence, moving the wood toward the blade in one direction only, from right to left, with a guide on the saw table to stop all cuts 1¼" short of an edge. Turn the wood over for the alternate cuts. Keep the uncut portion always against the fence, which travels towards the blade with each shift made.

Nail the plywood around a disk of ¾" pine 7⅛" in diameter, bending the sheet and keeping the open cuts spread ¼" apart. The disk is raised ½" from the bottom to keep it off the floor

Make a ½" by 1" whitewood ring on the jig saw and sand it smoothly to an inside diameter of 8⅝". Set the ring against a concave guide on the drill press to rout a groove, using a ⅜" router and setting the depth stop to ¼". Similarly, all the edges of the ring are rounded on the drill press with a concave cutter.

The ring is fitted over the top plywood edge. To spread the forked divisions evenly into the routed groove of the ring, use an extra 8" disk, pressing it down toward the bottom, gradually, until the correct spread is obtained. Glue in ⅜" fillers between each division. Finish off the bottom by winding

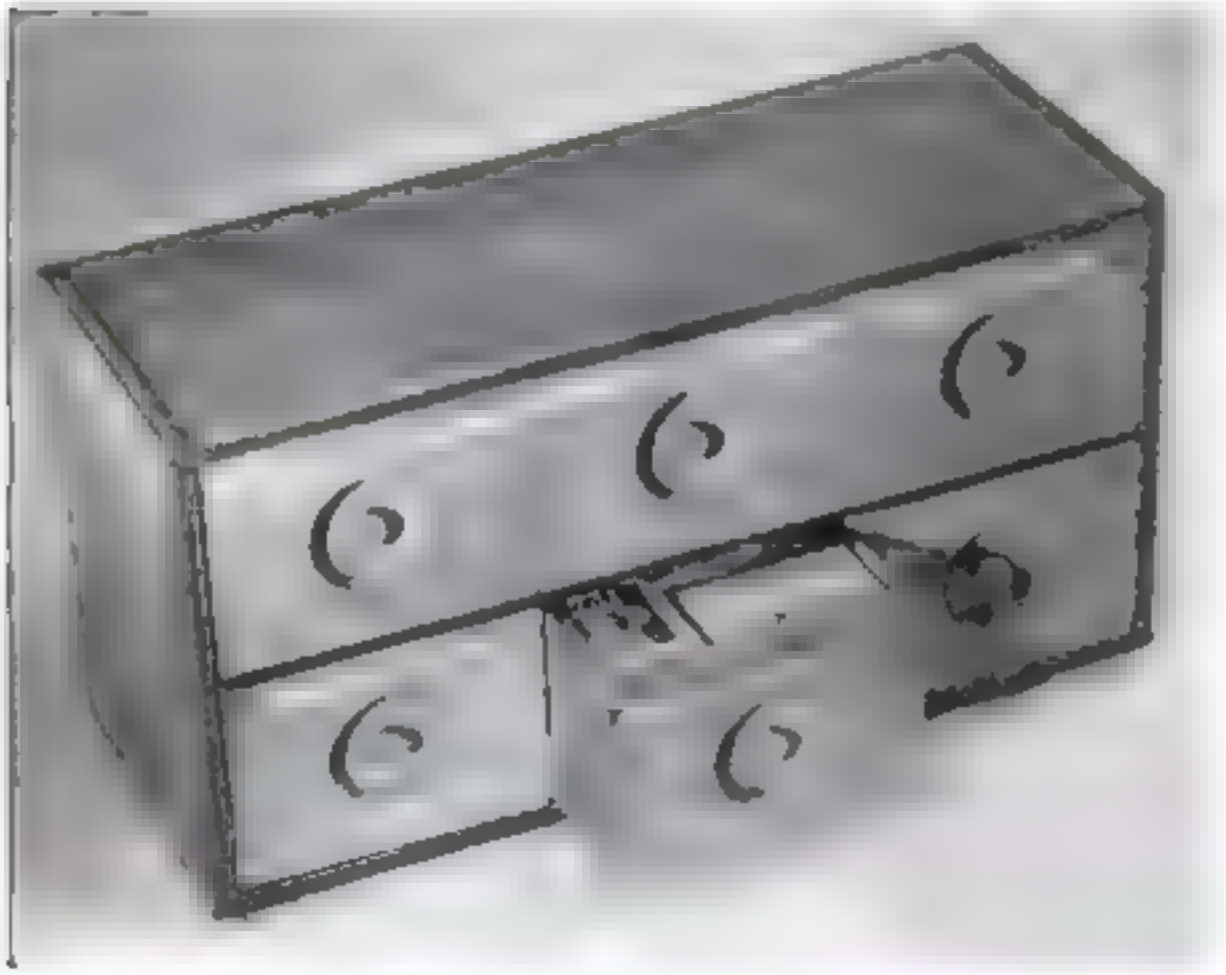
four strands of ¼" Manila rope around it. Start the rope between any ¼" division and end directly above, in the same notch. Glue the rope while winding.

Sand all saw-cut edges to prevent splintering. Fill any exposed core holes with plastic composition wood. Varnish with two coats, rubbing between, and wax. Paint the floor of the basket black for contrast. Working time: 4½ hours.

BORING BAR AND CIRCLE CUTTER. The drill-press operator can make several variations of this cutting jig to save time in cutting circles in composition board, fiber, or plywood. The circle cutter at *A* is made of 7/32" (or ¼") drill rod approximately 2⅞" long. It is cold-bent in the vise to form a parting tool ⅛" wide with a clearance at the heel of 9 deg The side clearance is approximately 5 deg Turn the cutting edge forward to an angle of 25 deg.

Flatten the shank and drill a 7/32" hole through the 3¾" length of ½" shafting. The ½" bar will fit into the chuck of the drill press, and the horizontal cutter can be set to any radius and locked by means of the roundhead machine screws. This makes it convenient for compound depth cuts or for cutting the outside diameter of large circles, to be routed out later on. The ⅛" bar is ground at the bottom to form a pilot bit ¼" long. This aids in steadying the tool, especially when the radius of the cut is increased.

The cutter at *B*, also of 7/32" drill rod, is flattened at the shank and bent with two successive right angles, brought forward 30 deg., and sharpened as shown. In use this tool undercuts inward slightly. Use both tools in combination for special cuts. Time, 3½ hours.



HARDWARE CABINET. Two or more of these can be grouped as convenient.

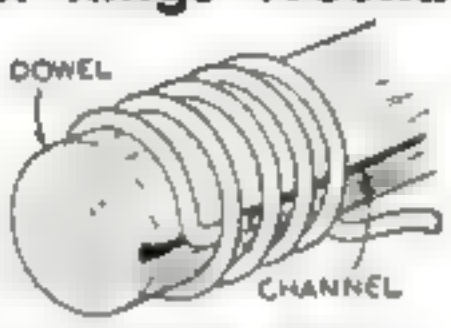
Six similar drawers of 7/16" pine have flush-recessed knobs which are centered on the drawer fronts. These are made on the drill press with the boring tool and circle cutter described above. The drawer walls and bottoms are of bent tin or scored cardboard nailed to the fronts and backs. The drawers slide against one another, no guides being necessary. The middle partition and back are 5/32" composition board.

The case proper has end-dado joints and is made entirely of ⅝" plywood, glued together. It is dimensioned to allow 1/32" between the drawers for easy action. Celluloid strips are cut to fit over the printed labels. Working time, 4 hours.

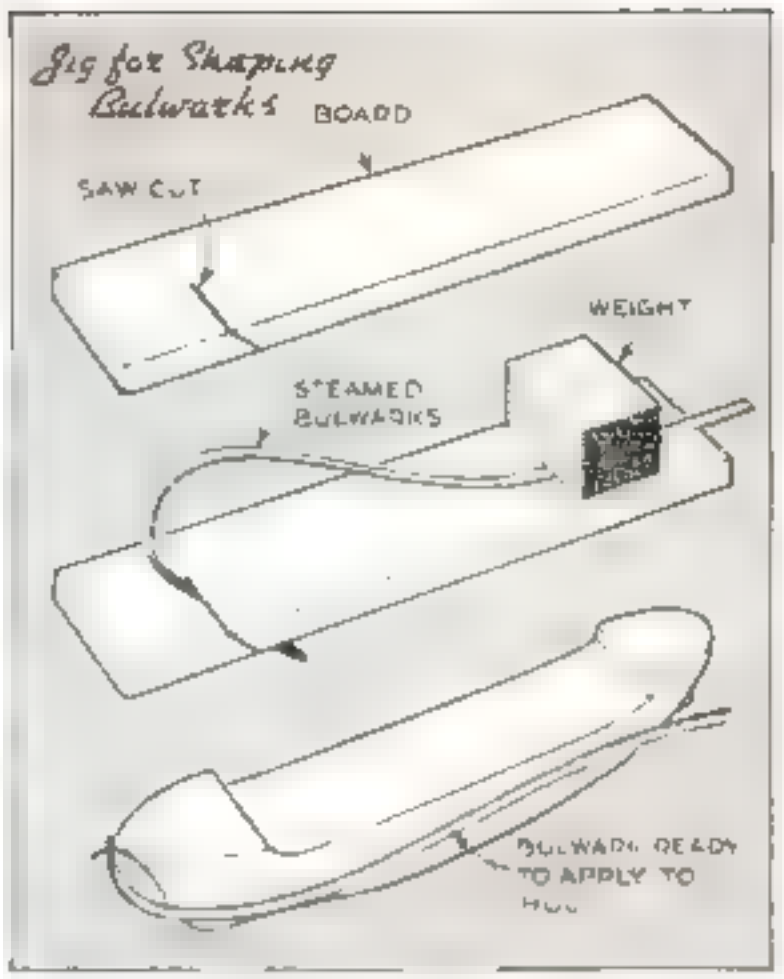
Taped Rail Keeps Locomotives from Slipping on Grades

MODEL locomotives, especially the light tin-plate variety, will pull better on grades if slipping is prevented by folding a ½" wide strip of adhesive tape over one of the outside rails. This simple aid has given good results on grades of as much as 10 percent. If the tape becomes oil soaked, it can easily be replaced.—C. ELMER BLACK.

Uniform Wire Mast Rings Wound for Ship Models



SMALL mast rings for ship models can be made by winding wire on a grooved dowel, as indicated in the drawing, and then using a pair of end-cutting pliers or scissors to cut each turn. A spot of solder is put on to join the ends.—PAUL H. SMITH.

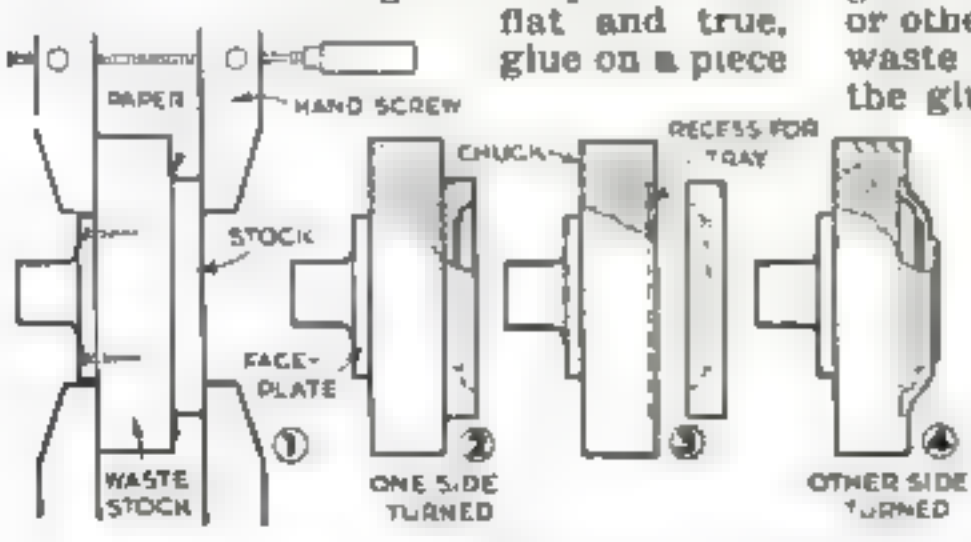


Model Bulwarks Bent to Fit Hull Tightly

SHIP-MODEL bulwarks, even when they are steamed, have a tendency to straighten out and pull away from the hull, especially at the bow. To overcome this, make a saw cut in a board at a slight angle, as shown in the drawings above, place the end of a steamed bulwark strip in the cut, and hold it with weights until it has dried thoroughly. It will then have a pronounced curve, and when nailed and glued to the hull, the piece will stay in place.—ANTONIO GELINEAU.

FACEPLATE TURNING WITHOUT SCREWS [WOODWORKING]

1. When screws cannot be used to fasten stock to a lathe faceplate, a piece of softwood plank, a little larger in diameter than the object to be made, is screwed to the faceplate and turned in the regular way. 2. When flat and true, glue on a piece of wrapping paper and mark diameter of stock to be turned with a pencil. 3. Spread glue over one surface of the stock, center it on the paper-covered disk, and clamp together. 4. When the glue is dry, turn one side of the tray or other object. 5. Remove work from waste stock by driving a chisel into the glued joint to cause the paper to split. 6. A shallow recess is now cut in the waste stock equal to the outside diameter of the work. The latter must fit very snugly. If a little loose, place paper between the two pieces before pressing them together. This is called chucking. 7. Now finish turning and sanding the other side.



POPULAR SCIENCE MONTHLY SHOP DATA

Chickens for

NOT everyone can keep a cow, kill his own pork or find room to plant a victory garden, but when it comes to poultry and eggs, a 15-hen flock, kept in a corner of the yard, will provide an average of 1,800 eggs a year, plus 200 lbs. of meat for the dinner table.

Except in certain restricted sections of the larger cities, back-yard flocks may be established nearly anywhere if a few simple, common-sense rules are observed. Don't, if you value your neighbors' slumber, keep a crowing rooster. Don't place your flock too near a neighbor's property. Do keep the house and yard clean. These are the three fundamentals of chicken raising in town.

Food production experts says the home poultry flock can produce as much food value as a garden or a small fruit orchard. Keeping 15 hens, preferably of a dual-purpose breed, will not only save you money, but will also better your family's health by supplying the table with five eggs a day, thus helping fill the need for strength-building protein and fat. Egg production is heavier in the spring than in summer and fall, but selling your surplus in the early months will help you buy eggs, if necessary, during the period of lesser production.

If you want eggs only, keep White Leghorns. For both eggs and meat the Barred Plymouth Rock, New Hampshire, and Rhode Island Red will give good results. About 60 chicks will supply 15 pullets and several fryers for eating. This number allows for the usual mortality and the expected proportion of males and females.

You may hatch your own chicks, using either setting hens or a mechanical incubator, but the easiest and safest thing to do is to buy day-old chicks and rear them in a brooder heated by electricity or oil. The average price for pullorum-tested day-old Plymouth Rocks and Rhode Island Reds is expected to be 16 to 20 cents apiece this coming spring; that for White Leghorns, 14 to 18 cents. Many hatchers guarantee "sexing," which means at least nine in ten will

HW 544

Everyone

By ANDREW R. BOONE

be pullets. If you want a few cockerels for meat, these will cost much less than pullets.

There's no need to spend much money on equipment. A box kept in a warm room will serve as a brooder, or for less than a dollar you can make an electric brooder that can be kept in any sheltered place.

Make the brooder before buying the chicks. Obtain from a grocery two large paper cartons. Cut a 4" by 5" door into one side of each at floor level. Place the boxes together so the chicks may pass freely from one to the other.

Now pour three quarts of sand into an old 1-gal. can. Bury an electric globe about halfway in the sand, and connect it by an extension cord to a nearby socket. Over the bucket place a flat disk of tin or galvanized iron to reflect the heat downward. The disk should be at least 16" in diameter, providing an overhang of 5". Cut a hole in the center large enough to insert the lamp socket, and punch holes about 1½" apart around the edge. Cut strips of flannel or other white cloth long enough to hang to the floor when knotted through the holes.

Place the heater near one side of one box, water and feed in the other box. The size of the bulb will depend upon outside temperature and the location of the brooder. A thermometer held at floor level just inside the cloth strips should read about 90 deg.

After the first week, the chicks may be carried outside on warm days. Should they crowd into the brooder, turn the heat on again. A run, which can be made with thin 6" wide boards, should be provided early. Cut a third door in the outer wall of

Thin 6" w'de boards will make a back-yard run for the chicks on sunny days. Scatter sand on the grass to facilitate cleaning up

the unheated carton, as in one of the accompanying photographs, so the chicks can go in and out at will. A larger run will be needed as they grow older, and chicken wire should be placed around it to prevent escapes. Do not, however, let chicks run on moist earth. If you place the run on the lawn, scatter sand over the grass to facilitate cleaning.

After a few weeks, the flock should be removed to a more permanent structure. An old piano box, the upper half of the front closed with wire netting, and an adjoining run, will suffice. Many portable houses are available at moderate cost. A house of 60 sq. ft. floor capacity will accommodate 15 heavy or 20 light hens. Never face the house north. Be sure to enclose it tightly on three sides to prevent drafts and exclude rain. Provide two roosts and a dropping board 30" wide under them, with the rear section hinged to facilitate cleaning. Nail 2" wire netting above the board.

If there's no room for a yard, build in a sun porch. This is easily constructed of ½" mesh hardware cloth for chicks, or 1" mesh for hens, stretched over frames 3' by 6' long, made of 1" by 6" lumber, placed on edge. Place them side by side over the space available as a run, the length of the house, and out 6' or more.

Deep nests, one to each five hens, should be fastened to the outside of one wall. Eggs may be protected from dirt and scratches by filling the nest to a depth of 6" with rice hulls or other litter. A good size for nests is 11" high, 11½" wide, and 12" long. A hinged, sloping cover will provide easy access for collection of eggs.

To maintain the birds' health and egg production, proper watering facilities should be provided. Water may be kept in a trough or supplied by a drip device. Make sure it is kept fresh and clean. A continuous bubbling fountain will give less trouble than a trough. If possible, have the fountain project about 14" above a wire platform, which will reduce the danger of sickness in the flock. The overflow should drain through tile outside the house. Place the feed also in a trough on a wire platform.

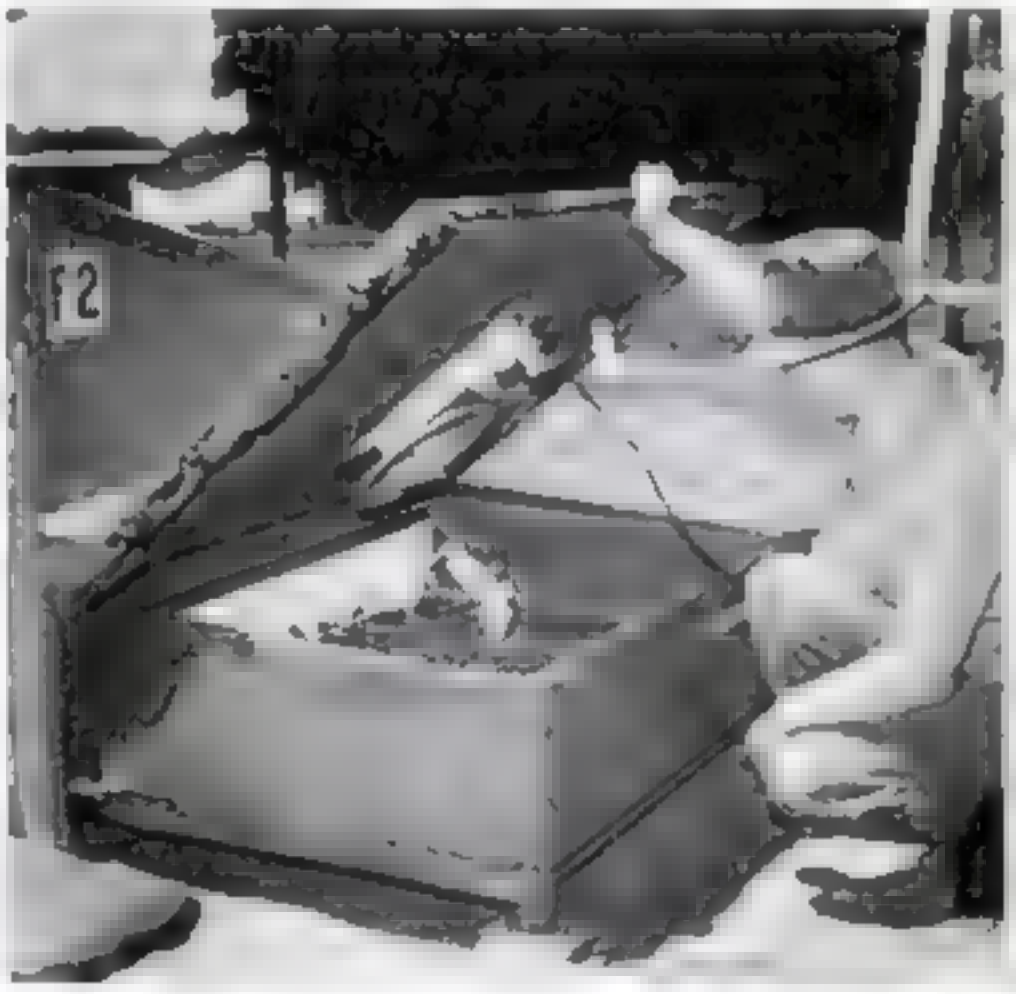
Table scraps may be fed to the flock, provided they include no spoilage. Chickens are particularly susceptible to botulism, so don't give them canned products you'd be afraid to have on your own table. Start feeding when the chickens are one day old, and keep them on a mash rich in protein for the first two to four weeks. Supplementing the mash, grain feeding should commence about this time, with one feeding a day, usually about an hour before sundown. For added vitamins, give them chopped greens within four days after they start feeding.

Because chickens are subject to many diseases, controls should be set up from the beginning. Be sure your chicks come from tested flocks. Disinfection of brooders and incubators will help prevent sickness for at least four to eight weeks. Strict sanitation, including such preventives as bubbling fountains and wire platforms, is the best preventive.

Here are some points to remember: To

Galvanized metal trough with a rotating bar on top will keep fresh water readily available for chicks

An electrically heated compartment will warm chicks during first weeks after their removal from cartons



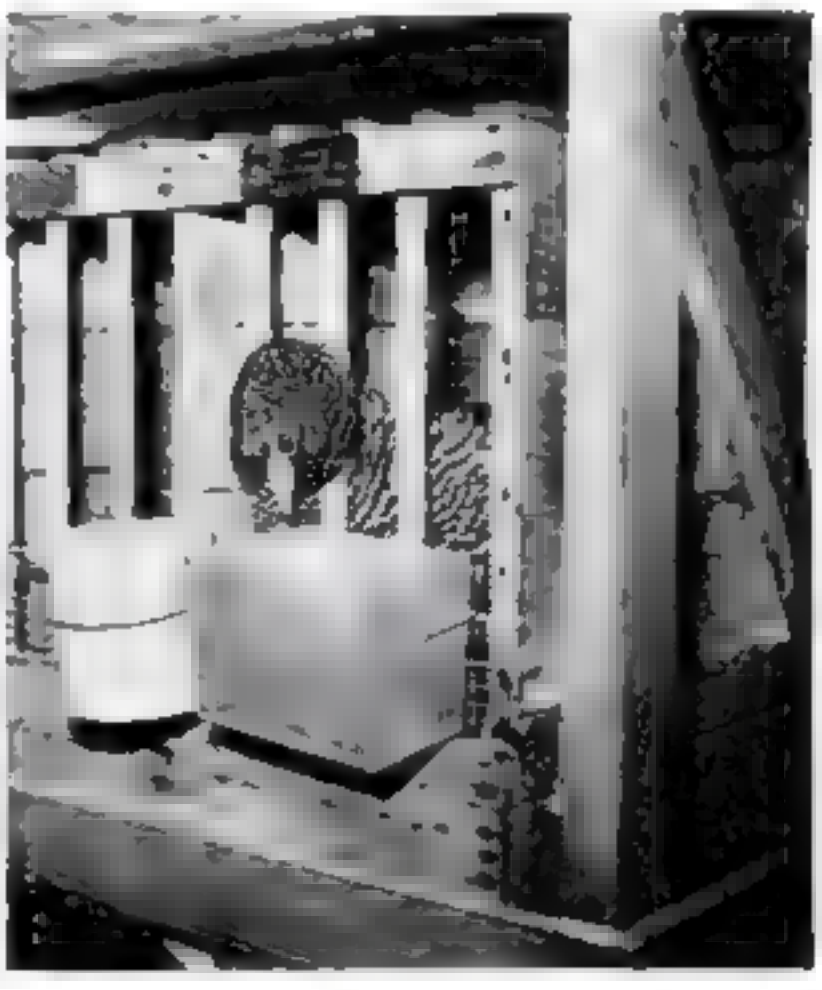
keep the 15-hen flock in good production, about two thirds of the birds should be replaced each year. Store all feed where it will be safe from insects, mice, and rats. Male birds do not help egg production and are an unnecessary expense They should be eaten. Cull out inferior layers during the summer months. The laying hens will have large red combs and will be in the best of health. Store surplus eggs in water glass. The meat may be canned, following pressure cooking. In canning, make sure you have adequate heat for sterilization and understand canning methods. In a dry season, eggs may be kept several days in a cool, moist room.

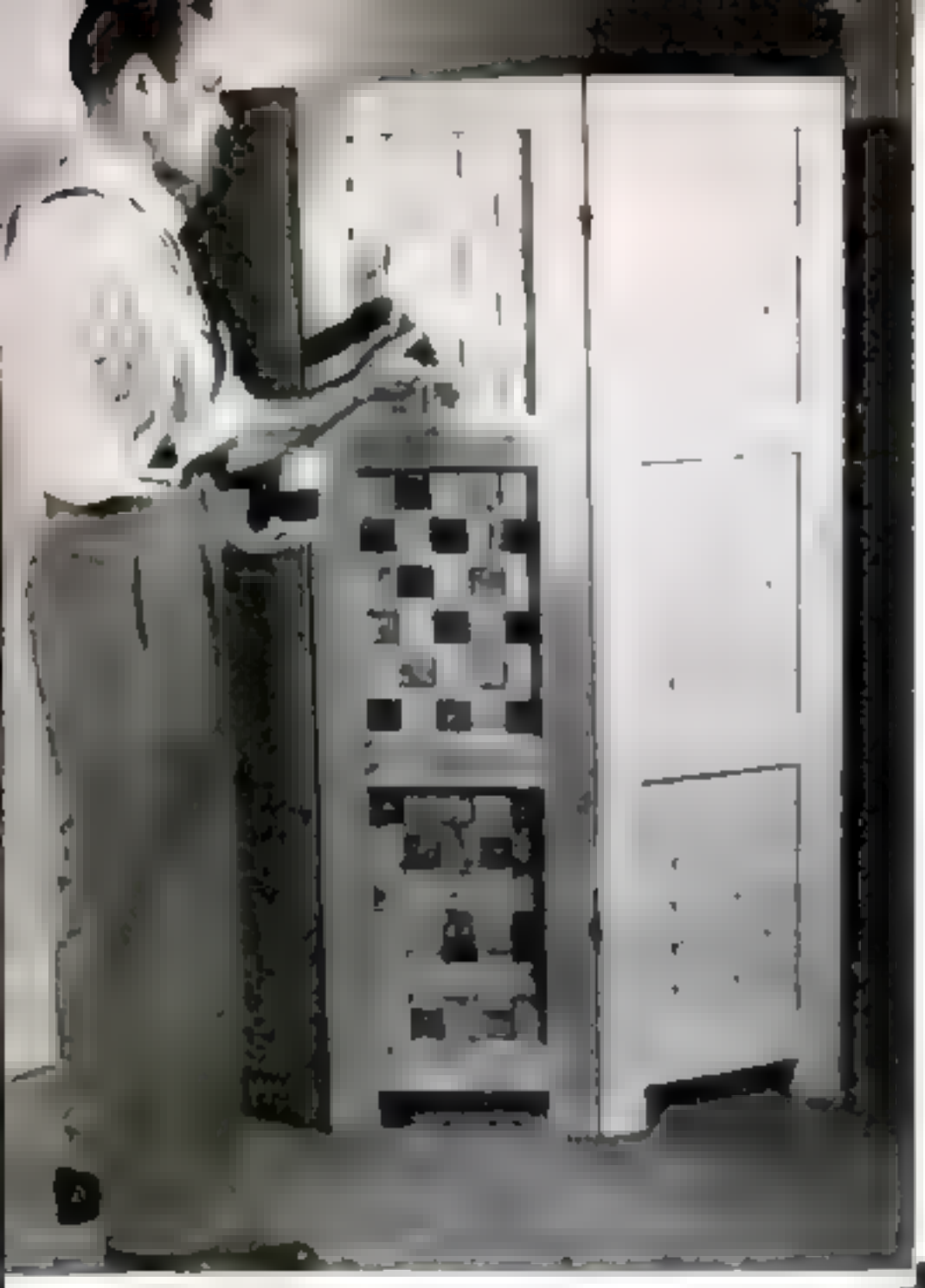
Problems not discussed on these pages will arise. When they do, consult your county farm advisor. He has circulars that will point the way to successful back-yard egg-and-meat production. Other helpful bulletins can be obtained through the Superintendent of Documents, Washington, D. C., at nominal cost.

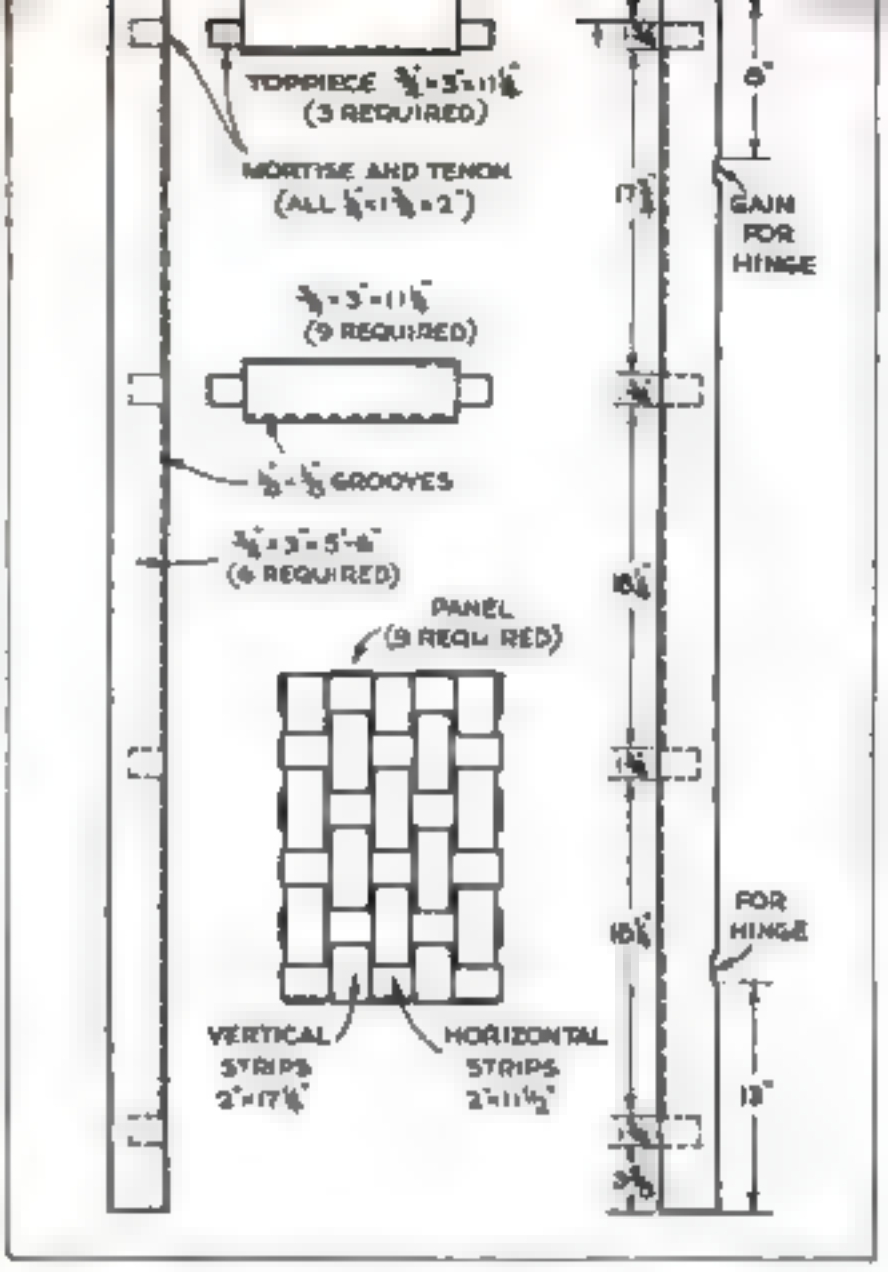
At right, wire platform around a water fountain keeps feet clean of droppings and will help improve the general health of your flock

Nests for birds in house should be built along a wall and covered by hinged boards

Inmate of broody coop has water and feed but no soft nest (below). A slat floor will serve







Uprights, crosspieces, and panels necessary for constructing the screen at left are cut as shown in the drawing. A finish of enamel is attractive

Panel Screen

WOVEN FROM STRIPS SALVAGED FROM BASKETS

By BENJAMIN NIELSEN

Strips from bushel baskets are soaked with water, dried flat, and then cut to appropriate lengths for assembling in panels as above

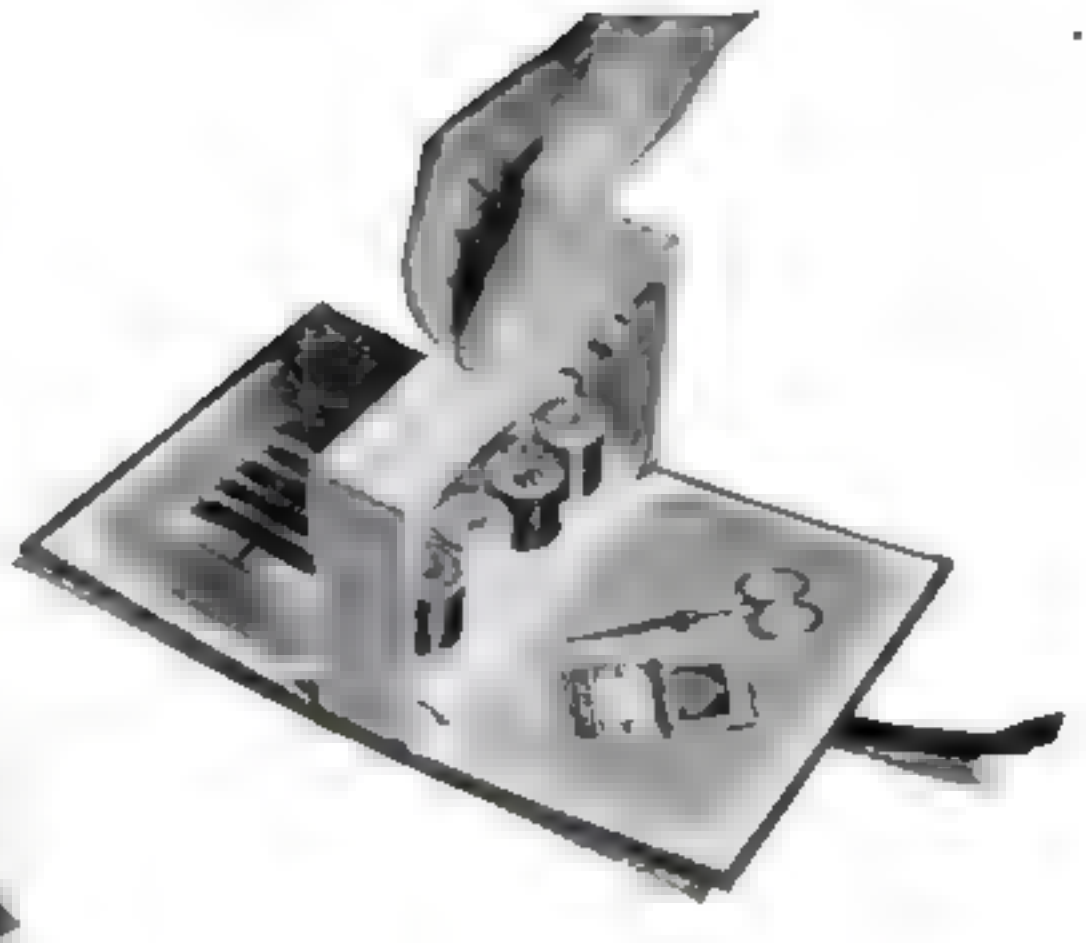
AN ATTRACTIVE folding screen made largely of waste material can be built with either hand or power tools. The panel sections are woven with strips obtained from ordinary bushel baskets. Baskets having rounded bottoms rather than the sharp edge are preferable, for they will provide longer continuous strips.

Sprinkle the baskets with water and allow them to soak; then take them apart carefully. Lay the strips out to dry, with small weights on top to hold them down flat. The strips are then cut into proper lengths and woven together.

Frames can be made from soft pine and put together with mortise-and-tenon joints, as shown in drawings, or with doweled joints. Groove the inner edges of the frame members to take the edges of the woven sections, and assemble with a good grade of glue. Join the three sections with double-acting hinges. Finish with two coats of flat paint, followed by one coat of enamel. Careful sanding should be done between coats for a smooth, professional finish.

IT'S ALL IN THE BOOK

Your Sewing Kit



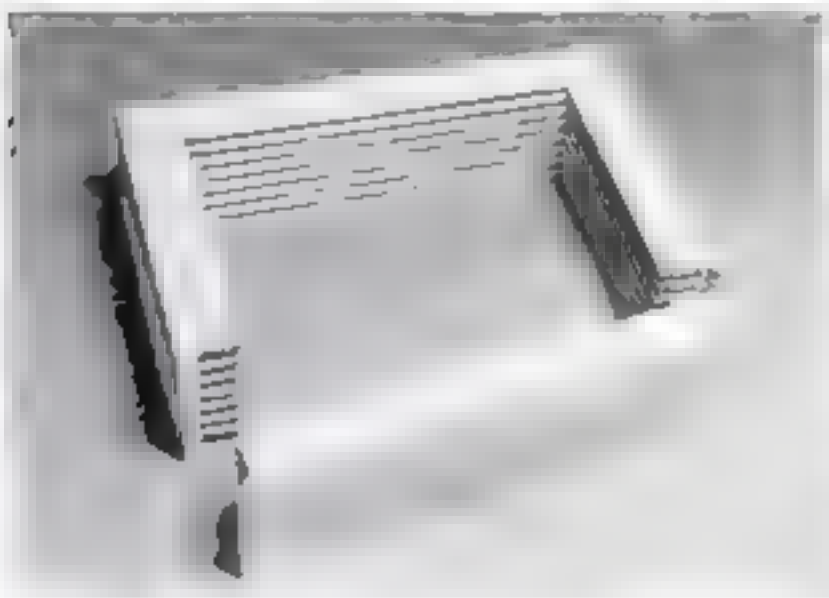
Above, sewing book opened and ready for use. Note that frame top forms a convenient handle. At left, the volume closed for carrying

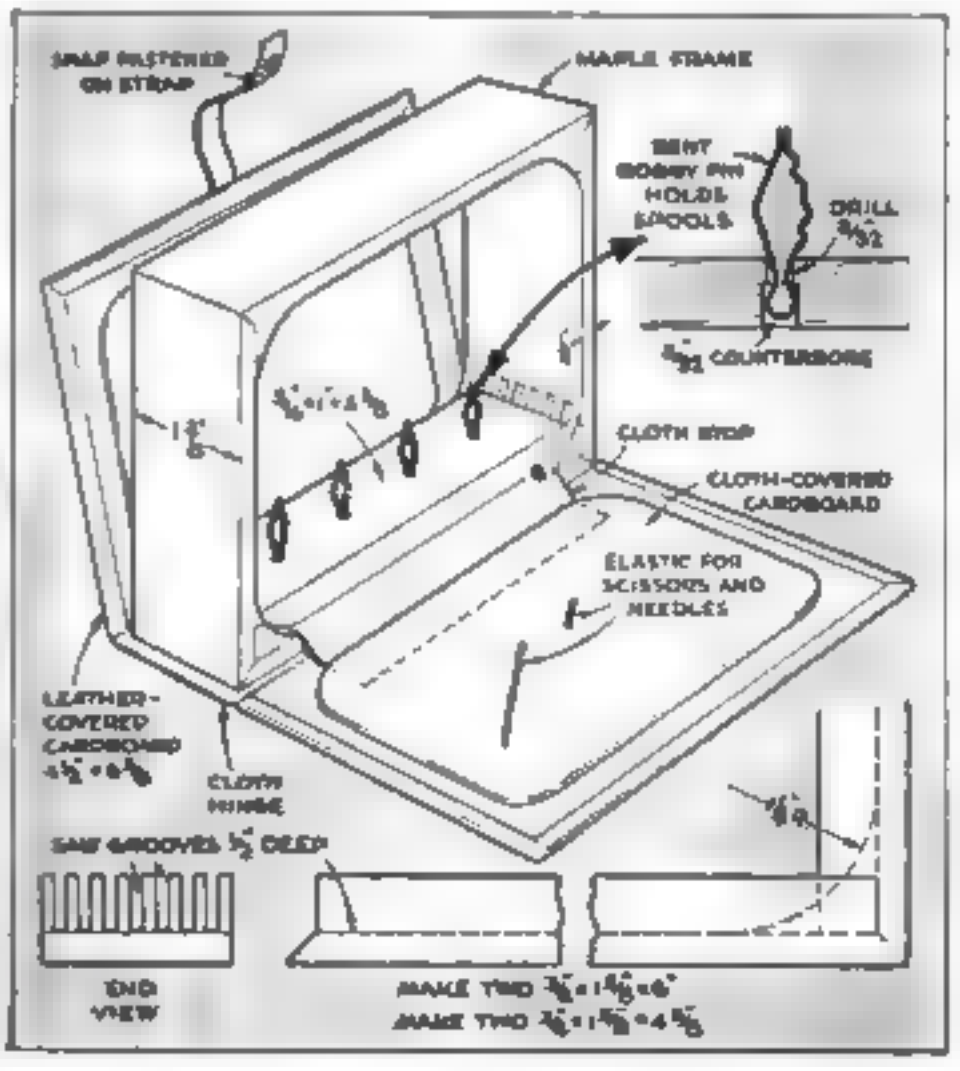
HERE is a little sewing kit that will please the distaff side of the family. On the circular saw, groove a piece of maple or other hardwood ⅝" by 1⅝" by 22" across its entire width to a depth of ½" as shown in the drawing. An improvised guide of tin, clamped to the saw table, will help to space the grooves accurately. Cut the four frame pieces to length and miter the ends ¼" in from the outer edge.

When the frame has been glued, jigsaw the surplus wood from the inside, and sand the inside surfaces. If you lack a drum sander, cover a 1¼" dowel with sandpaper and mount it in the drill press. Finally, plane or sand the frame to 1⅜" in thickness, making the two faces flush all around.

The covers are made by gluing two pieces of heavy cardboard to a single piece of leather or imitation leather. A snap fastener can be salvaged from a discarded pocketbook. Attach the covers with cloth hinges inside to reinforce the leather, and glue in a cloth stop over the inside of the frame. Over this glue the spool rack.—B. N.

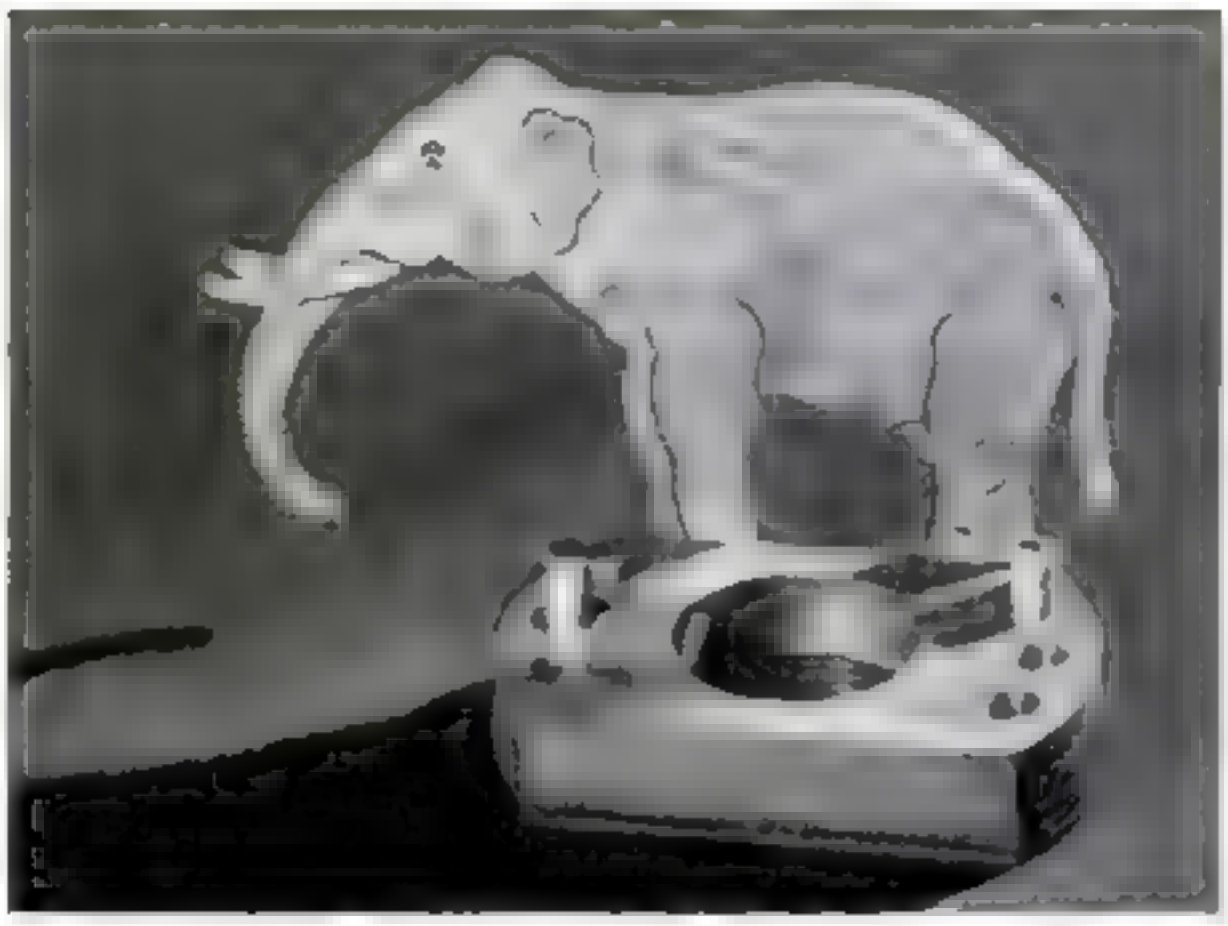
The grooved frame is assembled as shown below, and the surplus wood is jigsawed away from the inside as indicated on sketch at right. The frame is then sanded or planed to make joints flush





Tin Lining Makes Wooden Ash Tray Free from Fire Hazard

ONE disadvantage of wooden ash trays is that they may be blackened or even set afire by burning cigarette stubs. The one illustrated eliminates both this objection and the disagreeable odor of smoldering tobacco that often hovers about an ordinary ash tray.



A plate cut from a tin can is sandwiched between the body and the base

The smoker pushes a cigarette stub into one of the small holes, where it is effectively snuffed out. If all the holes are full, it is easy to remove an extinguished stub and throw it into the ash receiver. Both the snuffer holes and the ash receiver are bored all the way through the body, and a ¼" thick base of the same size and shape is then cut to match.

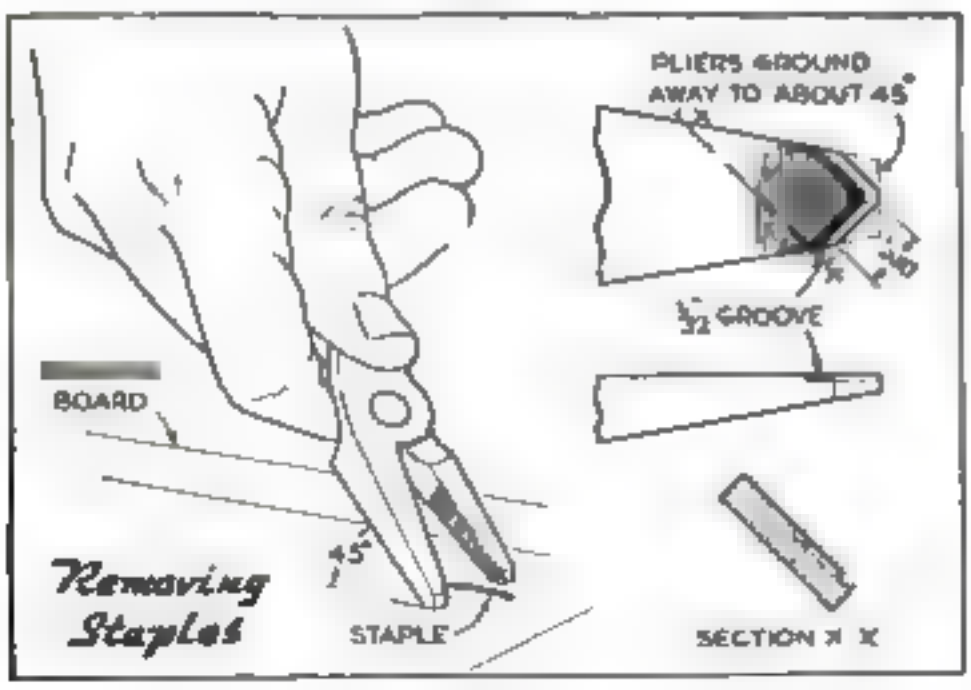
Between these two parts a sheet of tin plate (tin-can stock) is sandwiched. Holes are drilled through it for brads or screws that hold the wooden parts together. This tin plate insert protects the wood from heat where it is most vulnerable. Any suitable ornament may be used.—CLYDE S. SCRIBNER.

Operation of Jig-Saw Blade Improved by Teeth Filed in Back

WHEN medium or heavy saber blades are used in jigsawing where it is necessary to back the blade in the cut by reversing the direction of the stock, considerable difficulty is often encountered due to the packing of fine sawdust in the kerf, which blocks the return of the blade.

If a number of fine teeth are filed in the back of the blade, sawdust will be removed as the blade is backed.—R. W.

Quick-Acting Staple Remover Is Useful Tool for Draftsmen



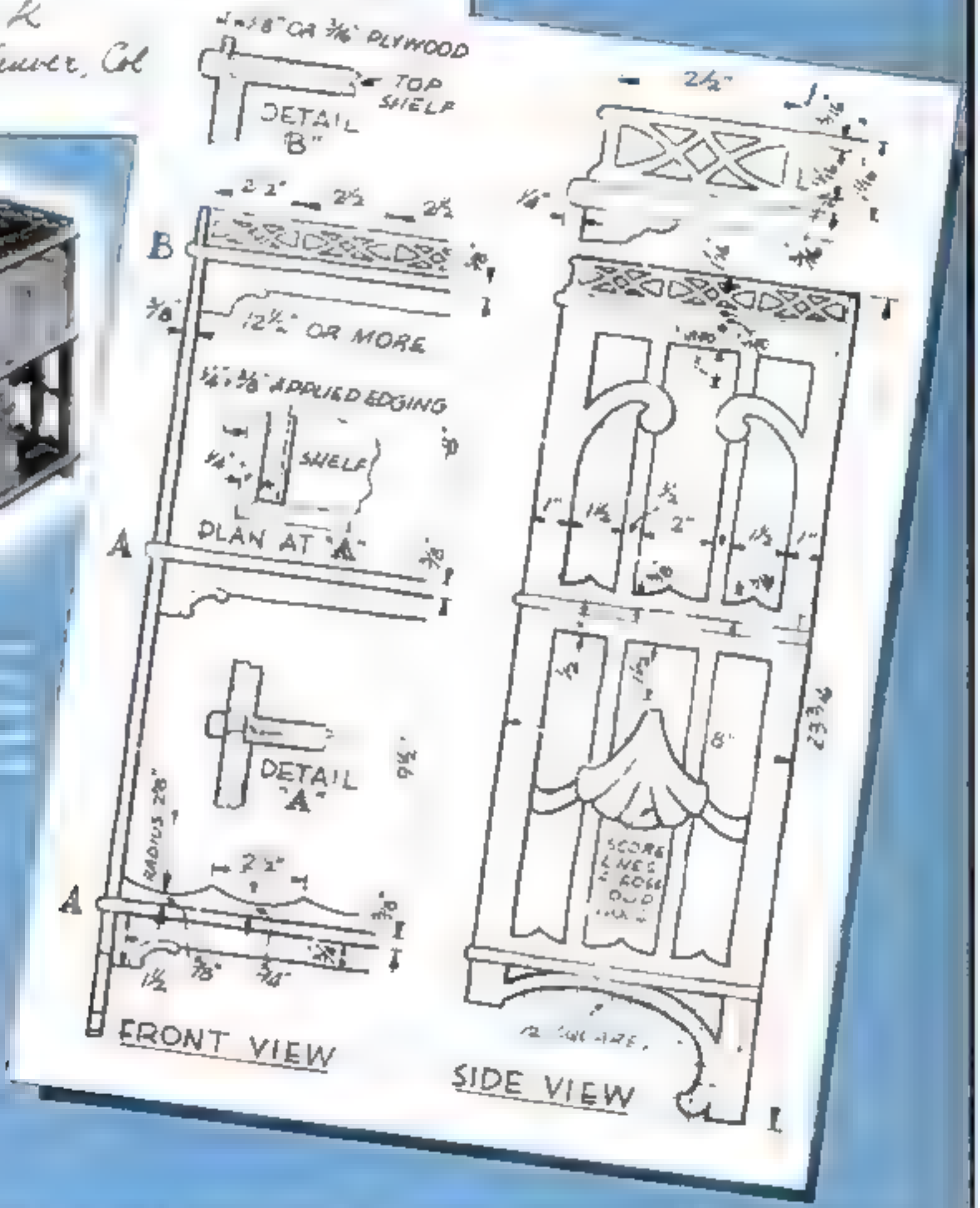
For ease, convenience and speed, a stapling machine is superior to thumbtacks or tape in fastening drawings to a board, and many draftsmen would prefer to use it if the staples could afterward be removed quickly and without damage to the paper. It is not hard to convert a pair of thin-nosed pliers of good quality into an efficient and speedy staple remover by a simple grinding and filing operation.

The pliers should be of a small, handy size. Each jaw is carefully grooved with a file, as shown, and then ground to form two hooked edges which grip the staple.—R. L. W.

Home and Workshop Department.

Can you suggest a design for screw-sawed wall shelves about 24" wide and 26" high suitable for a room furnished - more or less - in eighteenth century style?

A. L. K.
Denver, Col.



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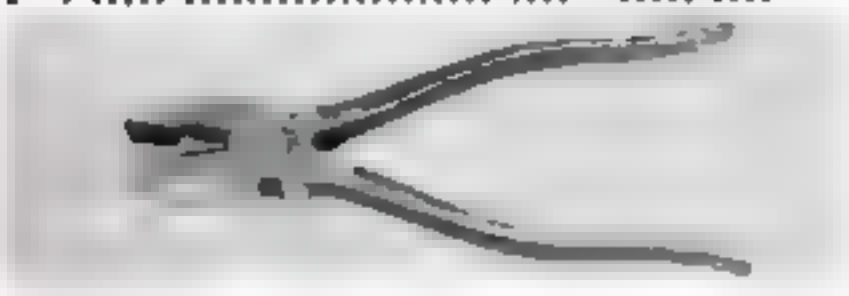

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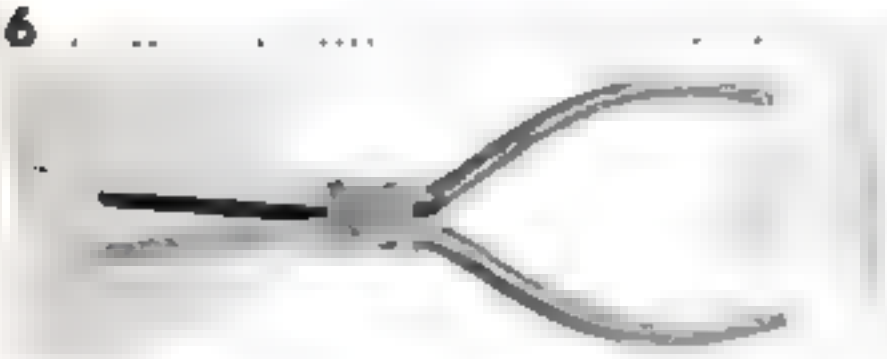

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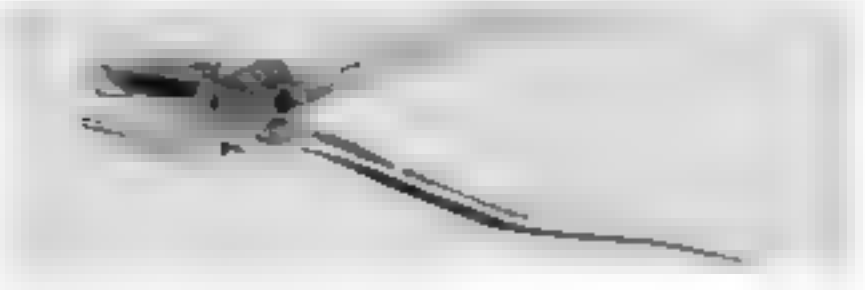


Question Bee

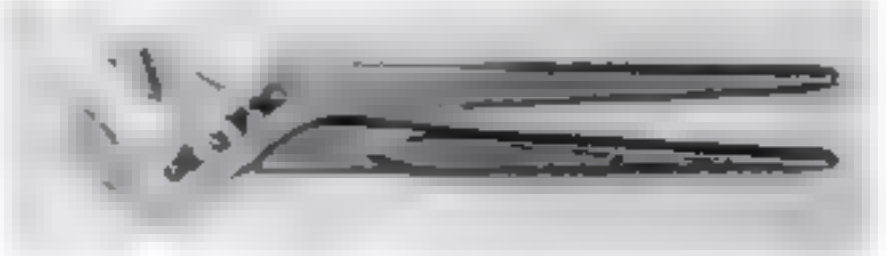
MANY years ago, back in 1923, POPULAR SCIENCE offered prizes for the best letters from readers telling which tool they thought the most useful one in the shop. Probably many others will agree with the first-prize winner, who wrote that the most versatile, all-around tool he had was a pair of ordinary slip-joint pliers. Certainly, this familiar tool lends itself to a great many uses, both orthodox and unorthodox, and has done yeoman's service in pulling many a mechanic, handy man, and automobilist out of a tight spot. But there are almost as many special types of pliers as there are novel uses for ordinary ones. Can you recognize the various kinds illustrated on this page? Write in your answers; then turn the page upside down to check them.

ANSWERS

1. Lineman's flat-nose pliers
2. Diagonal cutting nippers
3. Parallel-jaw round-nose pliers
4. Needle-nose pliers
5. Beveled-nose combination pliers
6. End-cutting nippers
7. Battery pliers
8. Wire-stripping pliers
9. Glass pliers
10. Long needle-nose side-cutting nippers
11. Water-pump pliers
12. Flat parallel pliers (French)

10

11

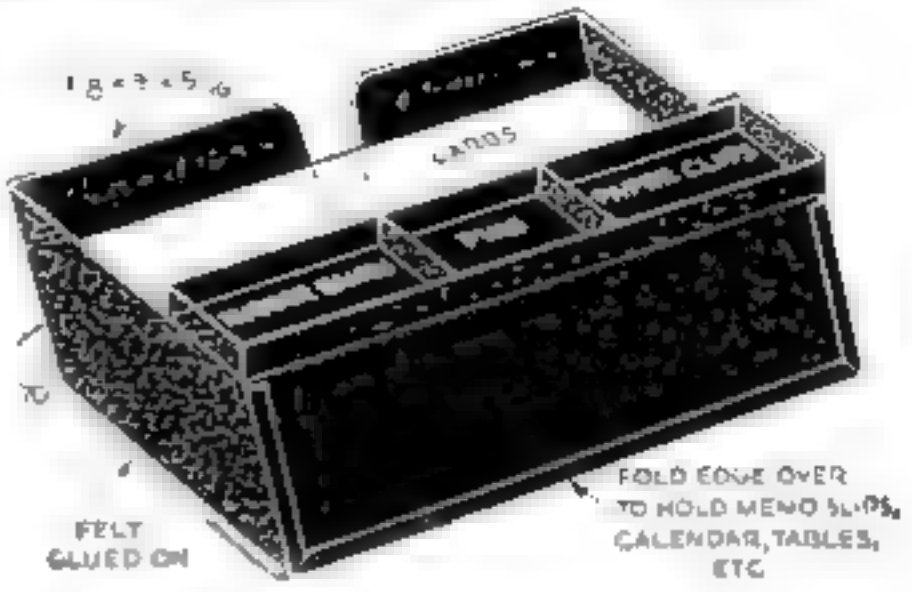


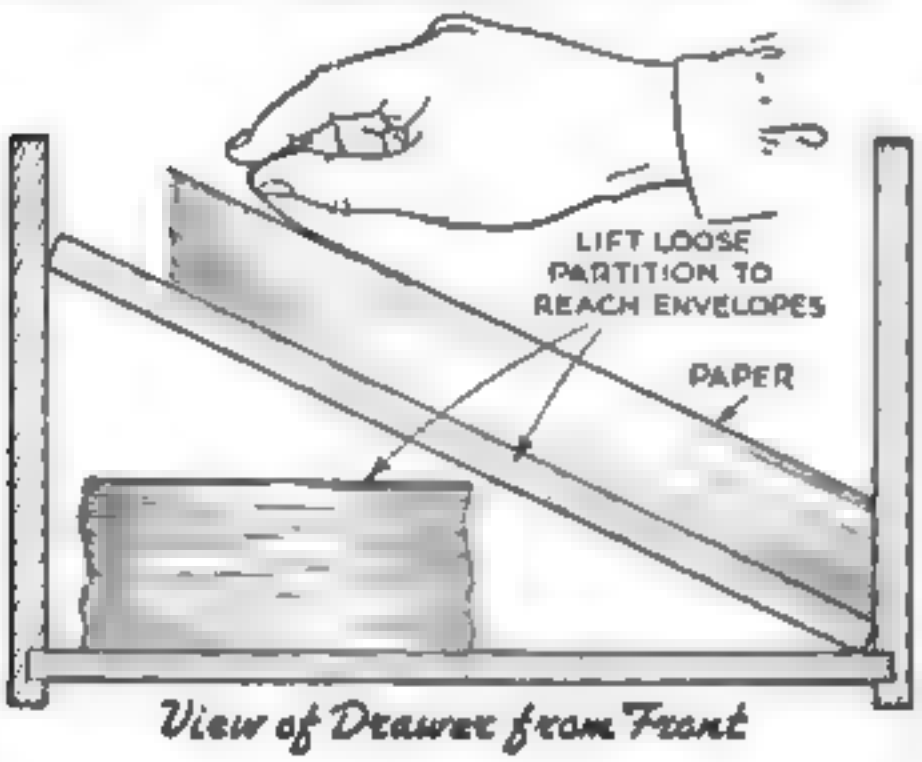
12

Holder Makes It Easy to Take One Memo Slip at a Time

ANYONE using 3" by 5" memo slips or file cards knows they are a nuisance if left in a drawer. If they are stacked in a box, it is hard to take out a single card quickly. This convenient holder staggers the cards so that the edge of the topmost one always projects a little farther than those below, making it easy to pick out one at a time. A handy tray on top is divided to hold rubber bands, pins, and clips.

The holder can be made of tin plate from discarded cans, with tin snips and a soldering iron as the chief tools. If preferred, ¼" plywood or thinner hardwood can be used. Wood can be stained and varnished to match other furnishings. If of metal, the holder can be finished in colored or black crackle enamel.—R. L. W.

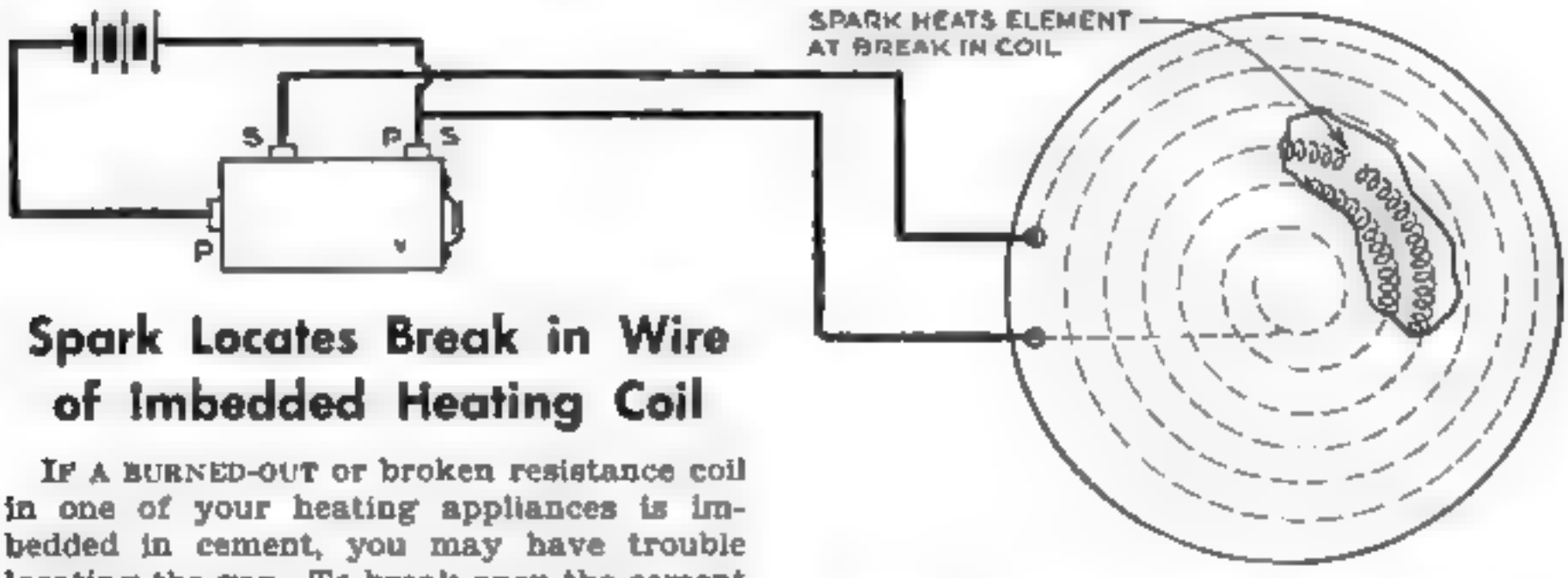




View of Drawer from Front

Slanted Drawer Partition Keeps Stationery Handy

You can store both paper and envelopes neatly in the same drawer and have the paper readily accessible by inserting a loose, diagonal partition. A partition to suit the drawer can be cut from a sheet of thin plywood, but a common dime-store bread board, 10" wide, fits perfectly in a typewriter paper drawer 9" wide by 5½" deep. A notch cut at the top permits it to be pulled out when envelopes are wanted.—J. M.



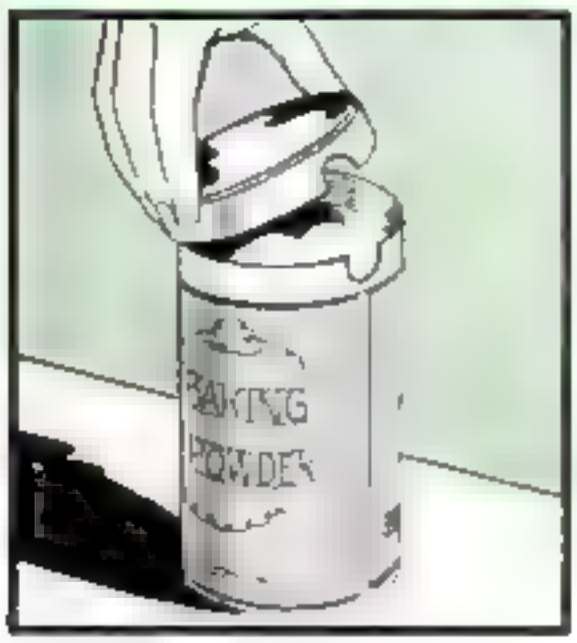
Spark Locates Break in Wire of Imbedded Heating Coil

IF A BURNED-OUT or broken resistance coil in one of your heating appliances is imbedded in cement, you may have trouble locating the gap. To break open the cement haphazardly may ruin the element. By using the following method, however, you can find the break without exposing the wire, and then make the necessary repair.

Attach the terminals of the element to the secondary terminals of a small spark coil, such as a Model-T Ford ignition coil, using a six-volt battery to supply the primary current. Where the secondary current jumps the gap created by the break, the heavy spark will heat the cement immediately above. You can locate the spot with a finger, chip out the cement at that place, and weld the wire or fill the gap with a conducting material. To complete the job, refill the cavity with asbestos cement.

If the appliance has a nondetachable cord, it is best to disconnect it rather than to send the high-tension current through the cord, for the current may persist in jumping across the lead wires before reaching the element.—W. C. WILHITE.

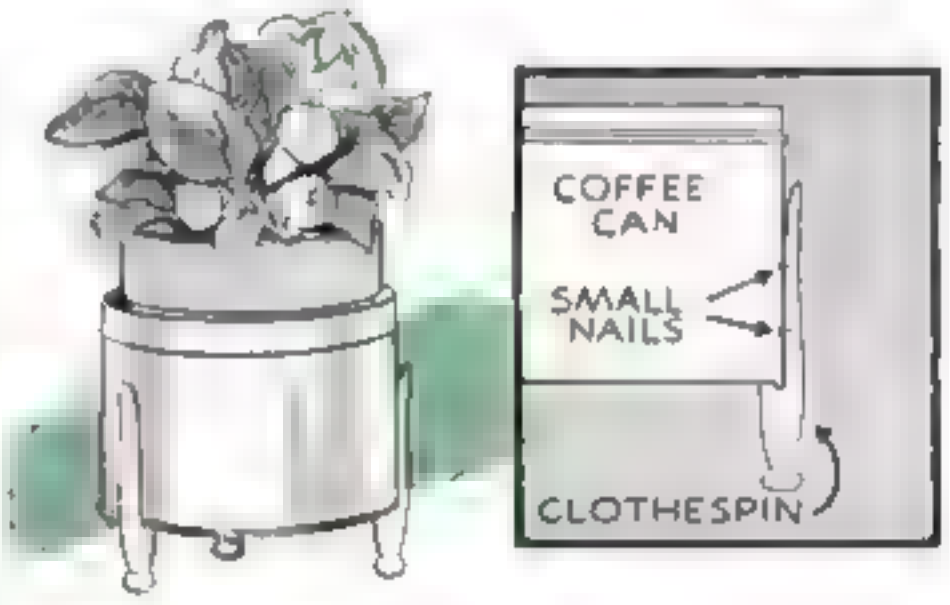
KEEPING THE HOME



Notches cut in the top and side of a baking-powder container, as above, form a good pouring device that opens with a turn

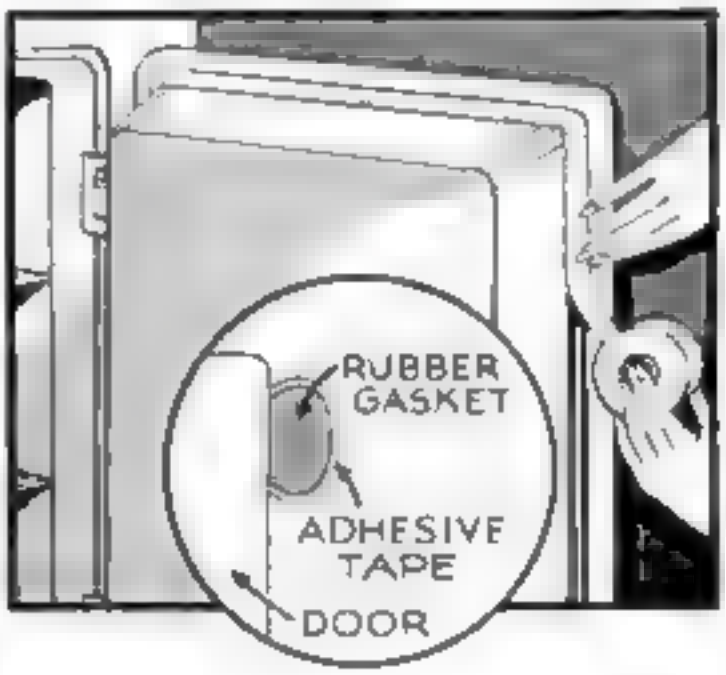
When a candle does not go into a candlestick squarely, soften the end in boiling water, and then press it in for a firm fit

Pieces of an old sponge can be made to give extra service if they are packed and sewed into a case made of a mesh dishcloth



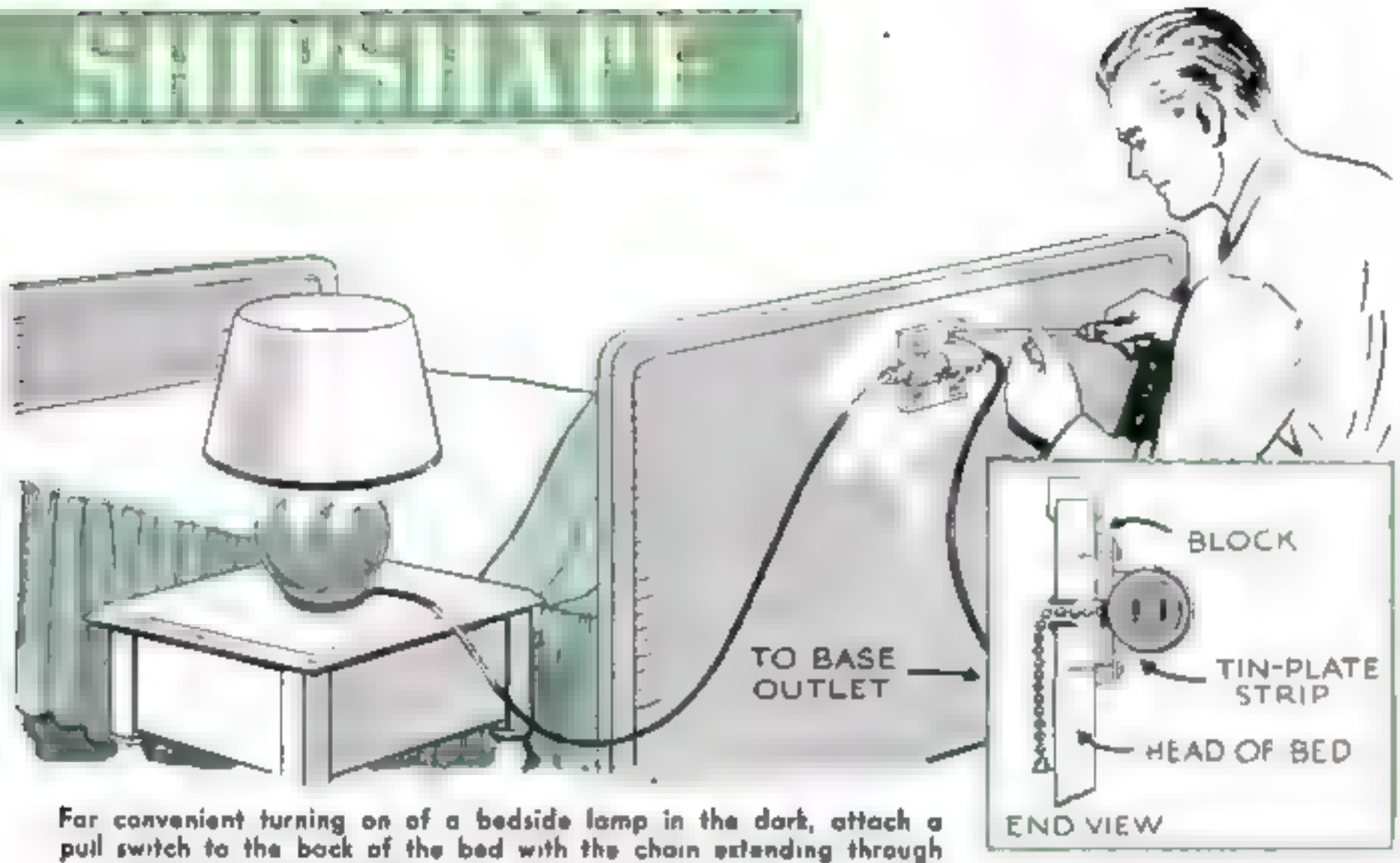
Three clothespins and an empty one-pound coffee can will make a jardiniere that will show off a potted plant attractively. Cut off one leg of each pin to fit the bottom rim of the container

Stairway sweepings can be gathered easily in a dustpan made from wood or an oil can. Have the front fit under the tread, and be sure the width is no less than that of the broom used

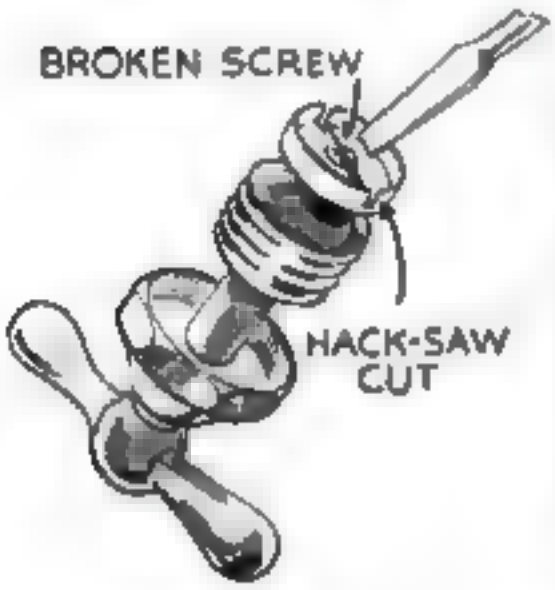


Adhesive tape covering the gasket on a refrigerator door keeps the rubber from becoming soft and repairs damaged parts

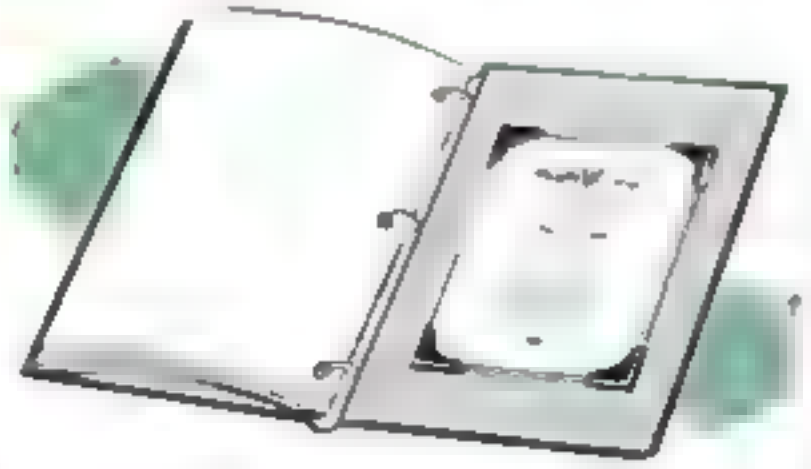
SHOPSHAPE



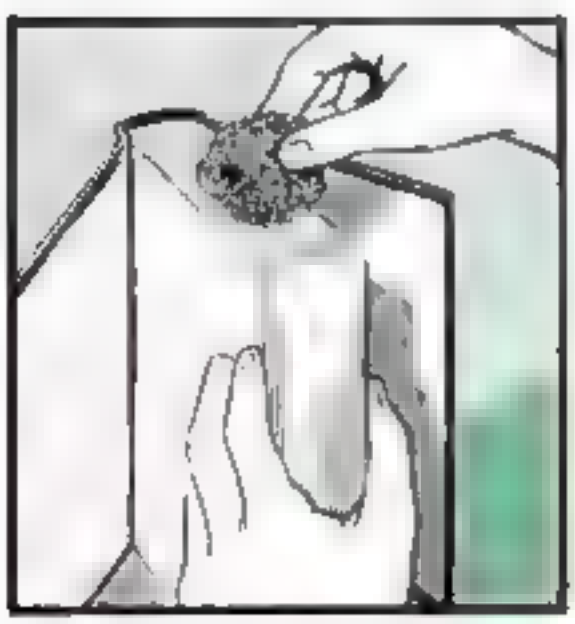
For convenient turning on of a bedside lamp in the dark, attach a pull switch to the back of the bed with the chain extending through a small hole, bushed with a brass eyelet to protect the wood finish



If a screw head in a faucet spindle shears off when a washer is being replaced, the screw can be removed by cutting a new slot with a hack saw, as shown at the left. The slot in the face of the spindle will do no harm since the washer will cover it

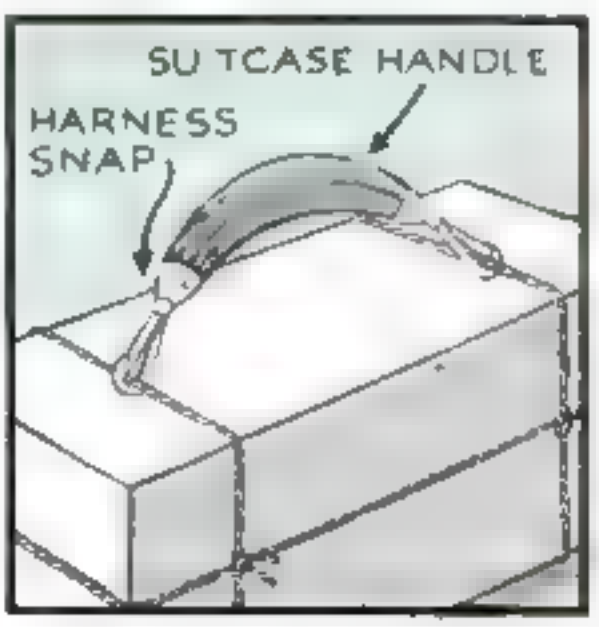


Blotters, cards, tables, or other needed material can be held on the inside of a book cover with four of the art corners used in mounting photos

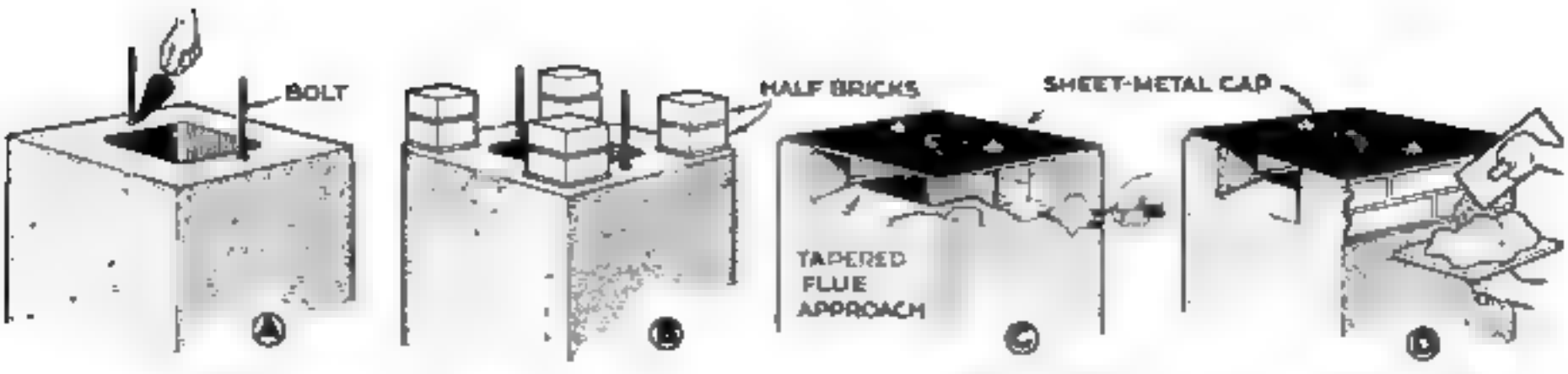


Steel wool will clean the tops of books if the pages are held firmly. Do not scratch the covers. Finish with a cloth

Transparent tape will protect data on a paint can from paint dripped over the edge, and it can be replaced when necessary



Attaching harness snaps to the eyelets at the ends will adapt an old suitcase handle nicely for carrying big, heavy packages



Cap on Chimney Will Keep Out Rain and Eliminate Down Draft

TO CAP a modern concrete-faced chimney for protection against rain entering the stack and to prevent down draft, first hole into the top with a star drill and cement in the heads of two carriage bolts of suitable length to serve as anchors, as illustrated at *A* in the drawing. Then, if capping only to keep out rain, build up the four corners with common brick to the height required by the size of the flue, as at *B*. This should raise the top enough to make the total opening of the four sides of the capped chimney equal to the original flue opening. For the sake of insuring a full draft under all conditions, however, make the total opening greater.

After the brick mortar has set, cut a sheet-metal cap out of fairly heavy stock (about ⅛") and fit it on the posts, drilling holes to permit the anchor bolts to extend up through. Then spread a batter of concrete over the top of the posts, set the cap true with the aid of a level, and screw on the anchor nuts.

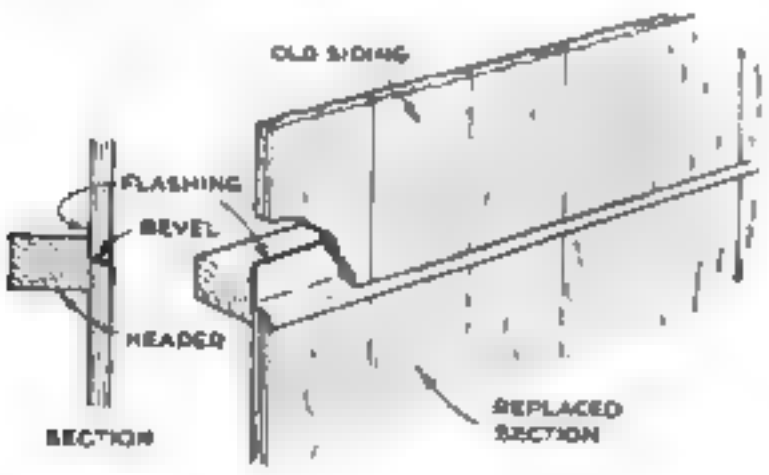
Lastly, face the posts to match the chimney facing, and build up the flue approaches under the cap in the tapering fashion shown at *C*. This will aid the stack in passing off smoke and will also shed rain driven inside by the wind.

If you are capping to prevent back draft as well, block off one or two complete sides by filling the space between the posts with brick and face them along with the posts, as shown at *D*. It may be advisable, however, to test the chimney under a complete range of draft conditions before applying the facing. If this is done, any alterations can be readily made in the brickwork.

Whenever the stack must be cleaned, it will be found a simple matter to unbolt and lift off the metal cap.—JOHN MODROCH.

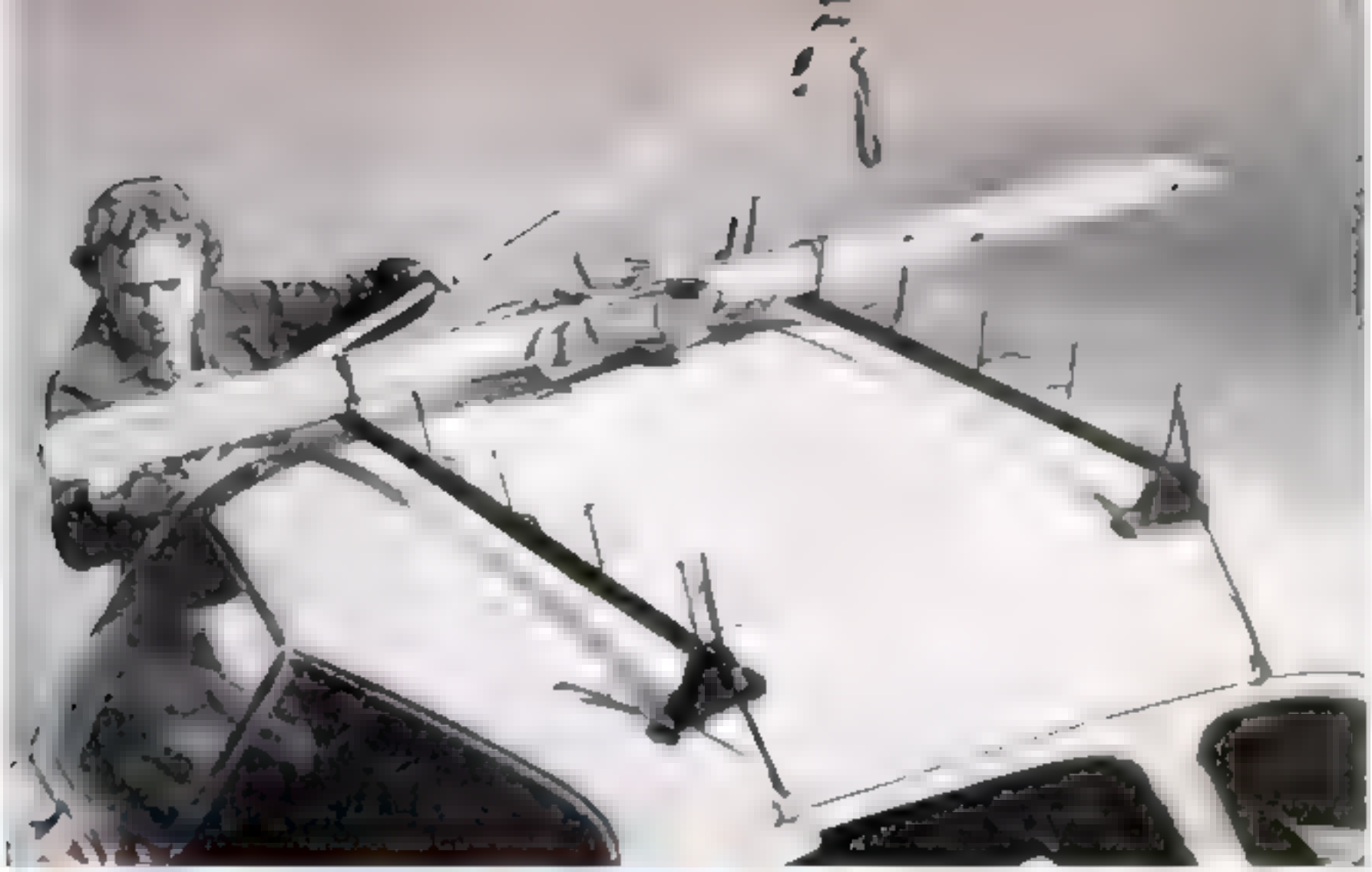
Metal Flashing Weatherproofs Patched-up Vertical Siding

IN REPLACING a damaged section of vertical siding on a cottage, barn, or similar building, the job can be made weatherproof by inserting a piece of metal flashing along the top and bottom edges as shown below. Bevel the ends of both the old and new boards to give the flashing a downward and outward pitch so that the joints will shed water. After the repair has been made in this way, the entire job can be given one or more coats of paint. Avoid driving nails through the flashing.—J. M.



Childhood Trinkets Preserved on Novel Jardiniere

An interesting way to keep old rings, buttons, thimbles, brooches, beads, necklaces and other childhood treasures is to decorate a jardiniere with them. Soak fine tissue paper in water, then boil until you have a smooth pulp. Mix in a small quantity of glue or gelatin. When the mixture has cooled, mold it over a bowl with your hands, allowing a little for shrinkage. As soon as the coating is firm, stick on all the small odds and ends you wish to preserve. After 24 hours, inspect to see that all are firm. Allow the pulp to dry about two weeks. The whole surface can then be finished with gilt paint.—MRS. K. R. SIPPLE.



PARK RANGER DESIGNS SIMPLIFIED SKI CARRIER

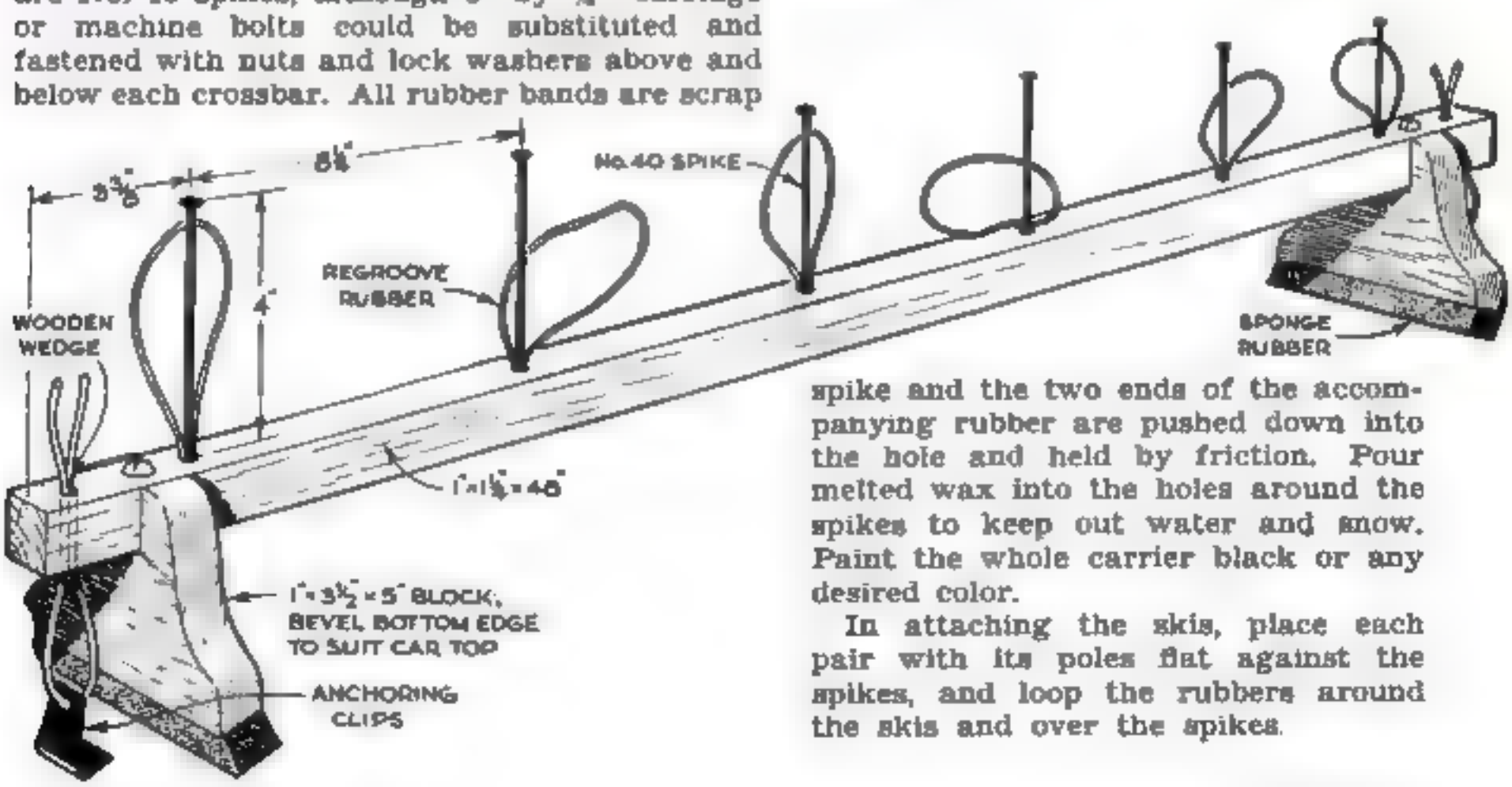
Using scrap materials to advantage, this home-built ski carrier compares favorably in utility and sturdiness with expensive commercial racks

FOR simplicity of construction it would be hard to beat this car-top ski rack designed by John Hansen, a former Yosemite National Park ranger now in the Army's Mountain Troops.

The main crossbars are 1" wide, 1¼" deep, 48" long, of oak or other hardwood. The four supports are 1" by 5" by 3½" softwood. The pegs are No. 40 spikes, although 6" by ¼" carriage or machine bolts could be substituted and fastened with nuts and lock washers above and below each crossbar. All rubber bands are scrap rubber obtained from a tire shop that does regrooving work, but if no rubber is available, cord may be used. Twelve 10½" lengths of ⅛" half-round rubber are adequate for the spike rubbers, and four 20" lengths of ⅝" half-round rubber for attaching the two carrier frames to the car. The four flat hooks are 1¼" by 2½" pieces of 16- or 18-gauge steel. Sponge rubber or other padding under the supports protects the car finish.

The holes in the crossbars are drilled slightly larger than the spikes. Each spike and the two ends of the accompanying rubber are pushed down into the hole and held by friction. Pour melted wax into the holes around the spikes to keep out water and snow. Paint the whole carrier black or any desired color.

In attaching the skis, place each pair with its poles flat against the spikes, and loop the rubbers around the skis and over the spikes.



HW 557

WHAT YOU CAN DO WITH

Portable Woodworking Machines

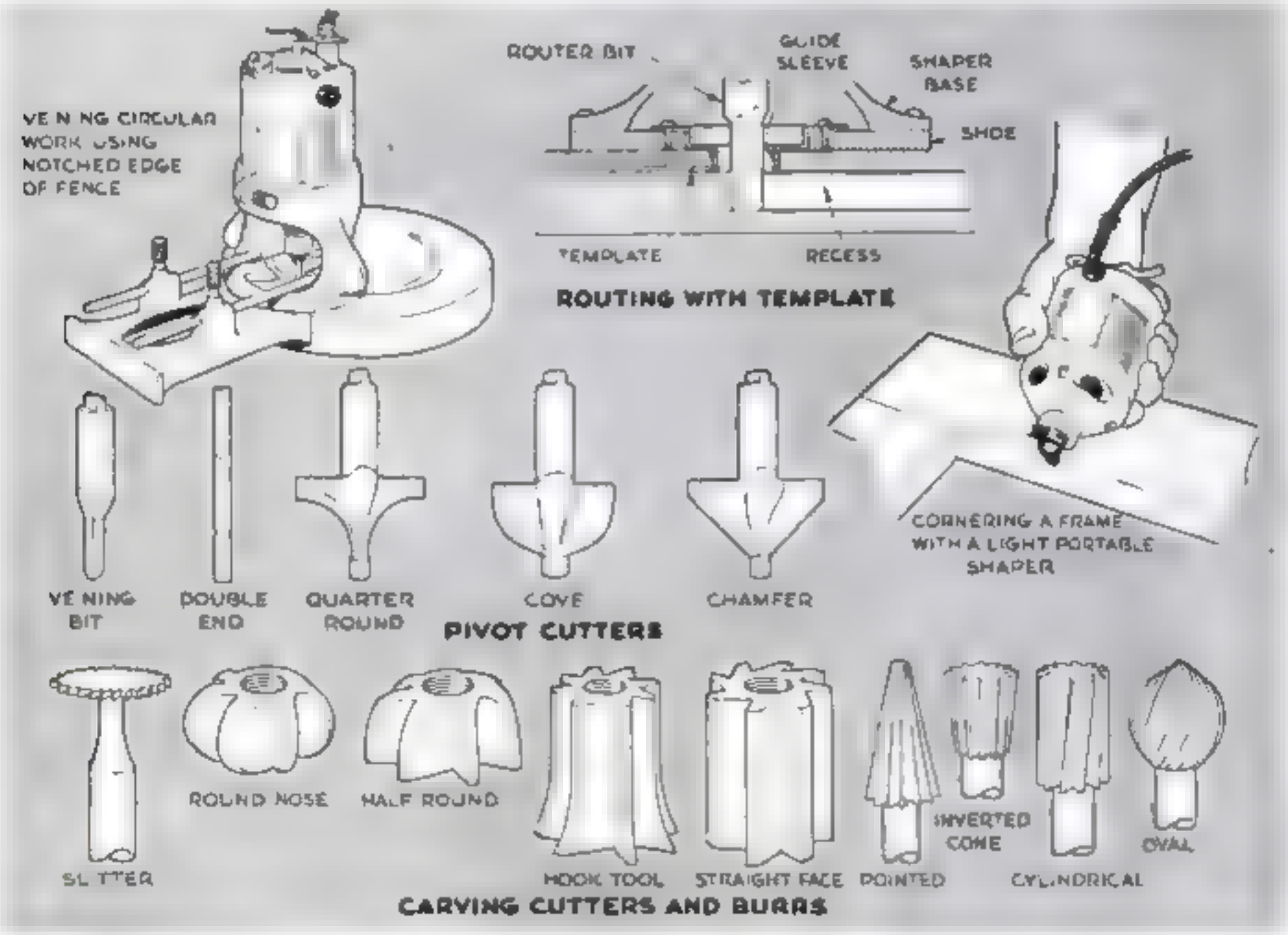
A VARIETY of portable machine tools has been developed in recent years. Many are of special interest to the home mechanic, for at times it is advantageous to be able to take the machine to the work. Some of these tools are suitable only for light, delicate tasks; others are adapted to heavier service, and will relieve the craftsman of much tedious labor.

What can be done with a portable router and shaper? The motor unit can be used alone or mounted in a base equipped with handles and an adjustable fence. To shape an edge, use a pivot-point wing cutter, and set the motor in the base at such a height that the pivot will bear against the lower part of the edge or against a template tacked to the underside of the work. The machine is pushed or pulled against the rotation of the cutter. It may be fed in at any point.

Clamp the work to the bench with the edge to be shaped overhanging, and shift the piece as necessary. If the cut is too heavy, clamp the motor higher in the base and make the molding in two or more passes. Avoid heavy pressure of the pivot point against the guiding edge, as this may burn the work and the cutter.

Veining is the cutting of a narrow channel, usually to a depth of half the diameter of the cutter, to produce an ornamental line pattern or a separation of light and dark tones or different colors. A thin plywood template makes an ideal guide. Attach to the machine a shoe carrying a sleeve, or on the smaller motors screw a guide to the chuck base, and let this slide along the edge of the template, which is tacked or clamped to the work. The template is cut along a line set back from the veining line by half the diameter of the guiding sleeve.

Portable routers and shapers are used alone or in a base with a fence. Cutters and burrs are numerous



By
EDWIN M.
LOVE

Routing is done with a router bit of appropriate diameter. Follow the template from left to right, outlining the limits of the routed part; then move the tool back and forth until all the inside waste stock is removed The template eliminates mistakes, and speeds production of duplicate pieces. To do routing on a single piece having straight sides or regular curves, use the fence. When square corners are required in routed work, trim them with a chisel.

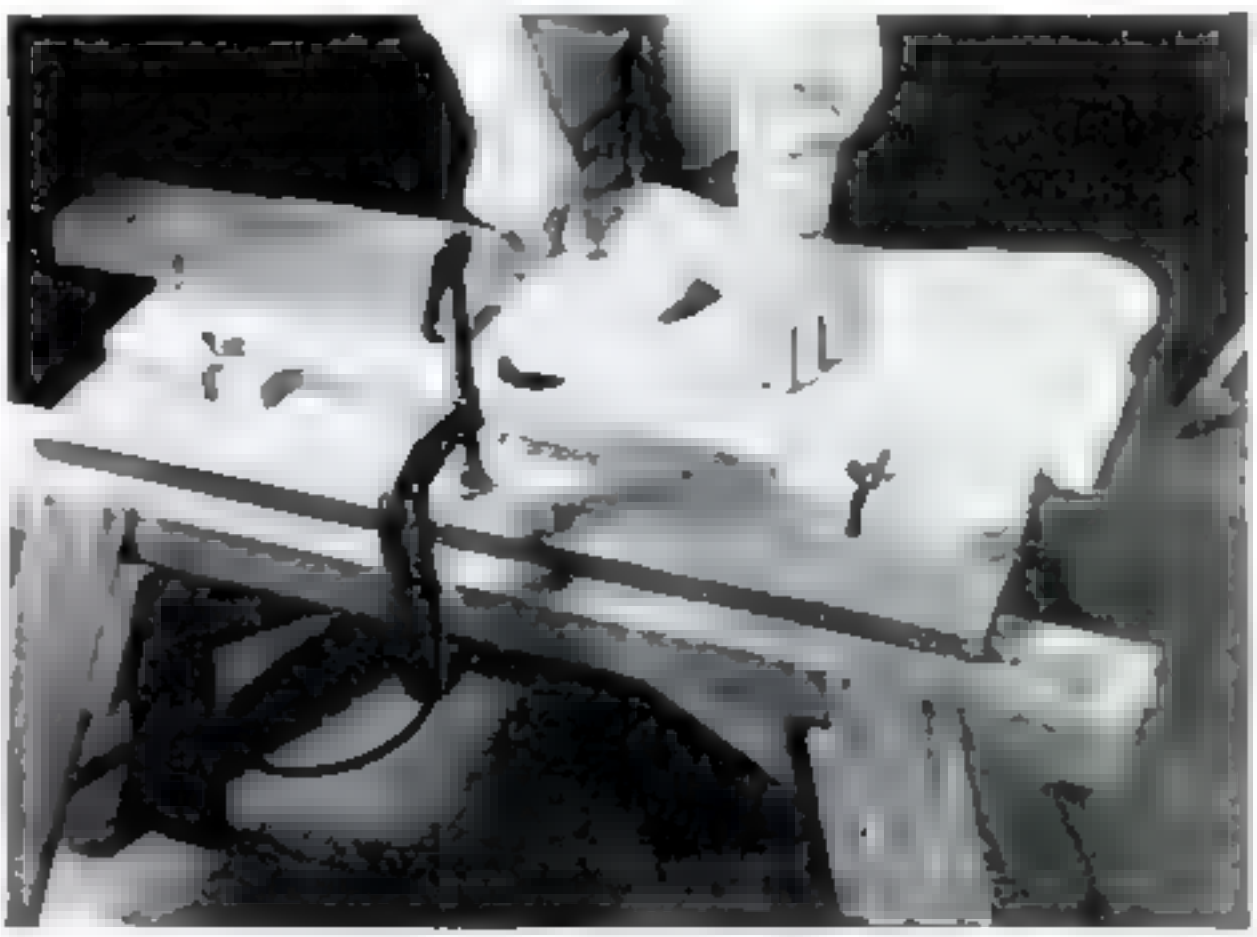
The portable router can also be mounted upside down under a base plate or table and used like a stationary machine.

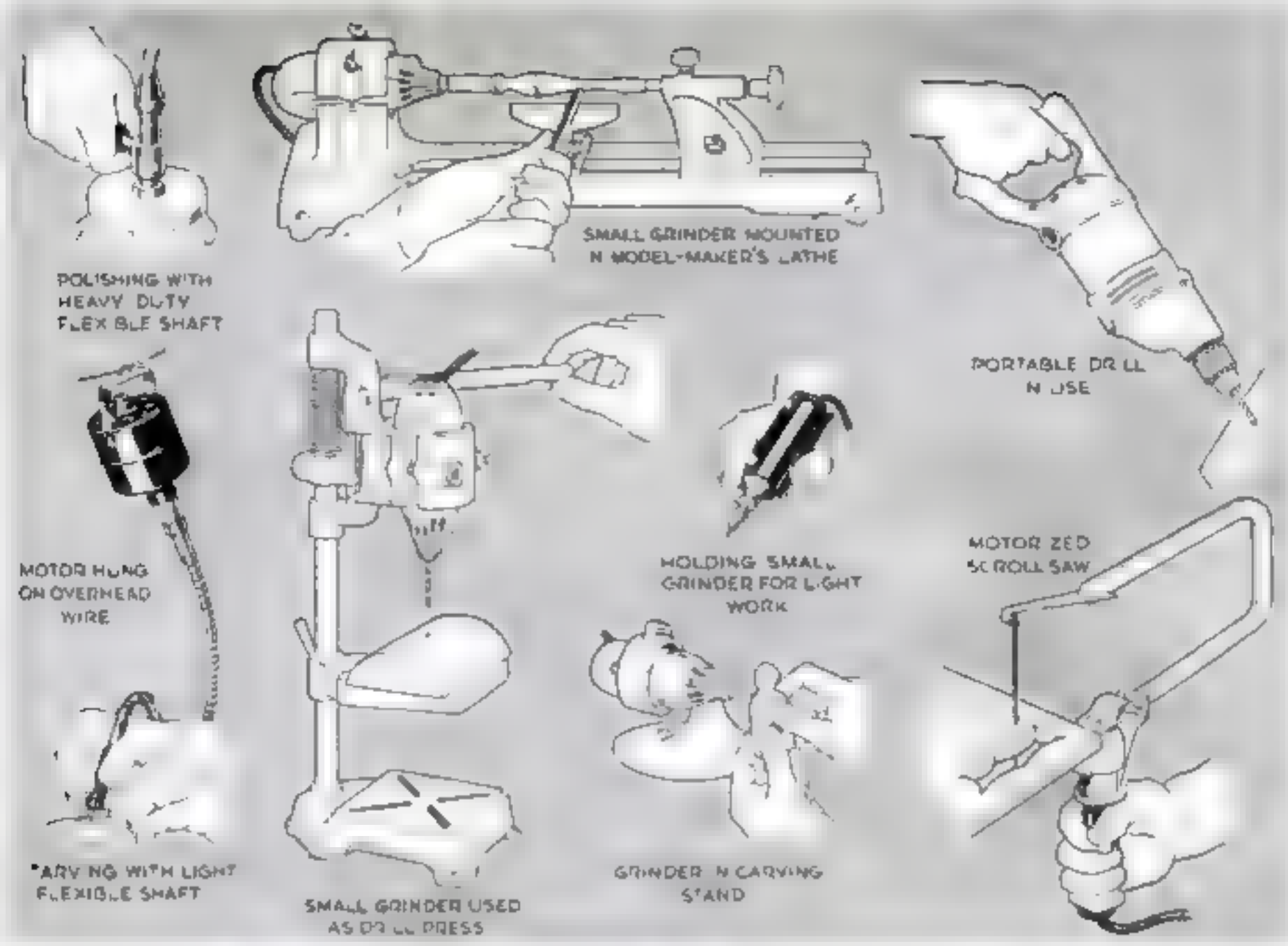
How can best results be obtained with a flexible shaft? The very flexibility of this tool, while allowing it to be operated from any angle, requires a firm grip on the hand piece, so that the drag of the emery wheel or cutter will not cause it to jump along the work. Advancing the tool against rotation assures maximum control. Grinding on a convex surface, as in smoothing a welded fender, should be done in a series of strokes with the angle of the wheel varying to suit the curve.

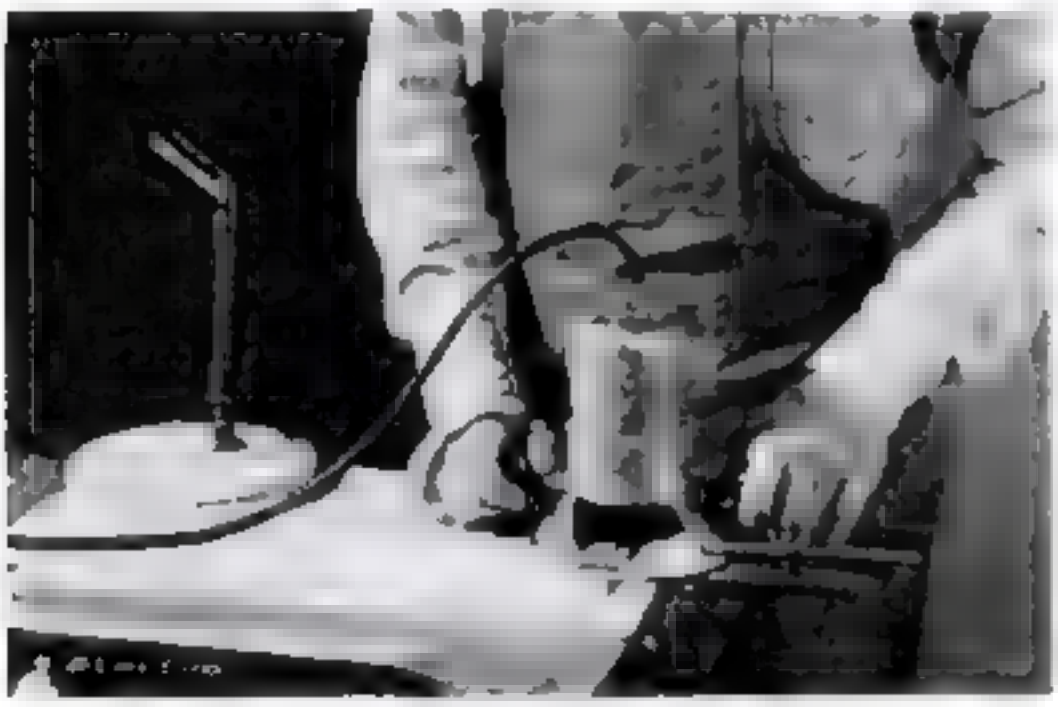
The flexible shaft is especially useful for drilling or grinding in narrow and restricted quarters. Where considerable accuracy is required, steady rests or jigs can be improvised to hold or guide the tool.

Light, high-speed flexible shafts are used with dental burrs and small

When edges are shaped, the work is clamped on the bench with one edge to be shaped overhanging, as above, and shifted as necessary. Below, a router is mounted upside down under the center of a base plate, and the work is pushed against it and a fence for rabbeting along the underside







Two types of flexible shafts, several attachments for use with hand grinders, a portable drill and motorized scroll saw are shown in the drawings. At left, a portable router is cutting a dado. The router is mounted in a base on which is attached a fence with a straight edge to hold against the work to guide the cut

grinding wheels in die making, model work, and light carving. The hand piece is usually held in the fingers like a pencil, for delicate manipulation.

How is a small grinding motor used? This also is held penciliwise for light carving and grinding, although there are times when it is best to grip the motor in the palm. Such a motor does the work of a light flexible shaft, and while it is larger than the slender chuck of such a shaft, it has only a cord to drag, instead of the shaft housing. It can be mounted in special bases as a miniature lathe, drill press, router, and shaper for all kinds of model work.

What is the right way to hold a portable drill? This type of drill is so light that it can be used in almost any direction by gripping the handle with one hand. When practical, the motor should be steadied with the other hand, for a drill is rather brittle, and a change of angle in a hole may snap it off. When using a fine drill, it is often necessary to lift the motor slightly, since its weight may break the drill.

Is any special technique involved in using a portable sander? It is handled somewhat like a hand plane, and a certain amount of deftness is required. Boards to be smoothed should be clamped down, and overlapping passes made from left to right, the full length of the work if the material is short enough. On long boards, sand convenient lengths, feathering the strokes by lowering the sander at the start with a forward

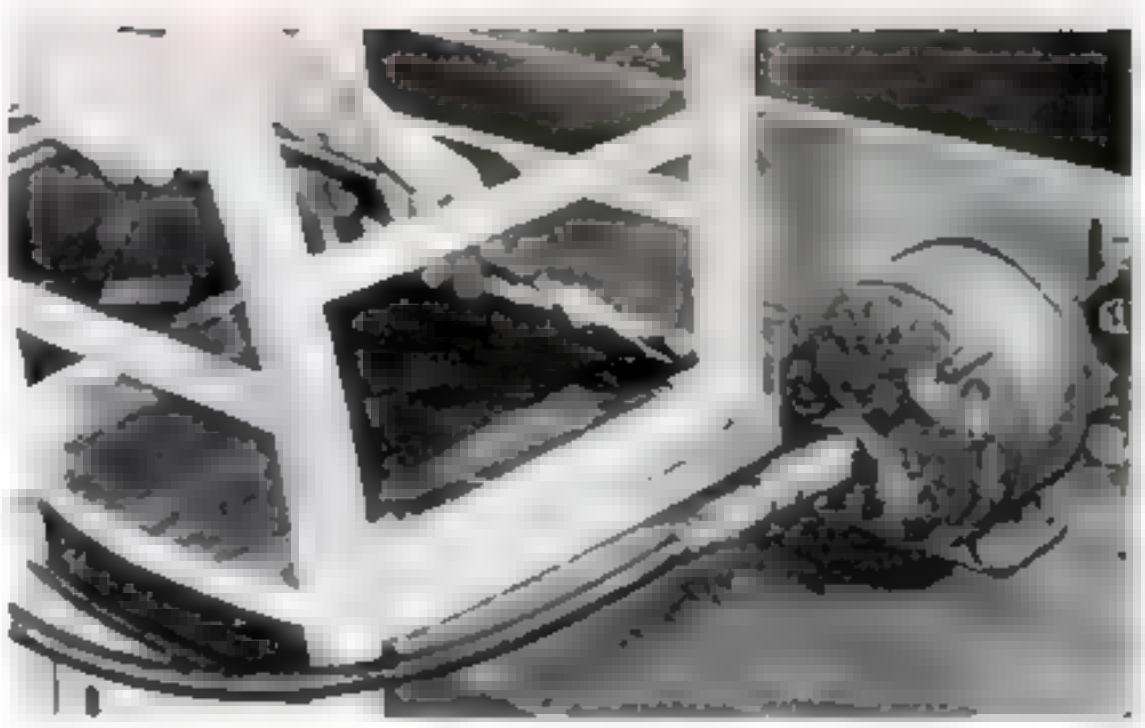
motion and lifting it at the end of each pass. Uniformity of pressure and pushing speed contribute to the quality of the finish obtained.

Use a belt of coarse grit for roughing and one of finer grit for finishing. To save needless wearing of the belts, use a machine or hand plane for the first smoothing. However, the sander proves its worth on cross-grained wood that is difficult to work by ordinary means, removing saw marks and chipped holes, and producing a silky surface.

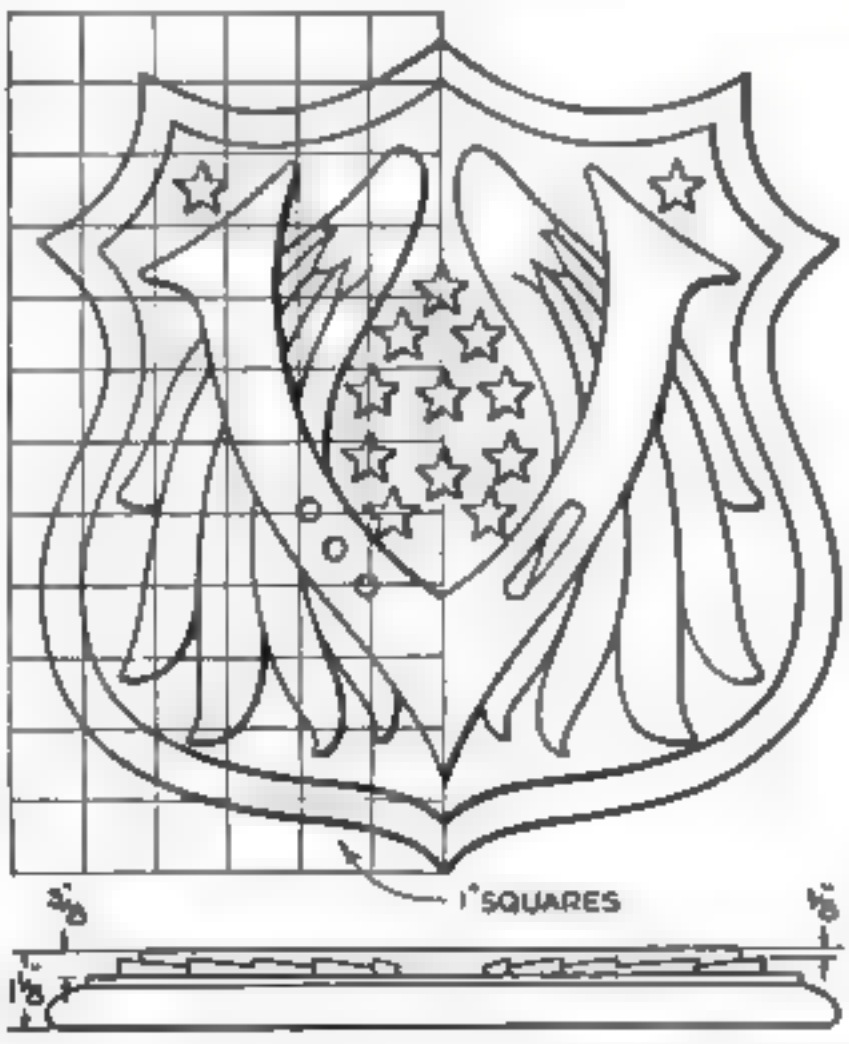
Convex surfaces are smoothed with rolling motions and crisscrossing of strokes, and are finished with movements along the grain.

Set up in a frame vertically, on its side, or upside down, the machine can be used like a stationary sander.

What are the advantages of a portable scroll saw? This tool can be plugged into any convenient light socket. The blade, held taut between an upper spring in the frame and a vibrating unit below, makes over 7,000 strokes per minute, cutting smoothly and requiring only guiding. It is handy in model work for cutting fine detail.



Drilling in restricted quarters is made much easier with the aid of a flexible shaft. Below, a portable sander puts a finish on a flat surface. On a short piece, make the passes full length



Shaped-and-Routed Plaque Embodies Victory Design

MAKING this plaque is an exercise in shaping and routing. The pattern can be enlarged by drawing it on squares of suitable size. Saw it out, smooth the edges, and run the molding on.

The figure is outlined either with a scroll-sawed pattern or freehand. Use a small routing bit for ease of control. Rout the background to the full depth of ⅜"; then reduce the wings and stars to a level ⅛" below the V. The feathers may be left flat and simply delineated with a veining bit, or tapered in thickness from the outside in by using a narrow wedge-shaped wooden shoe on the router to incline the bit.

Finish in natural varnish, in stain and varnish, or in red, white, and blue enamel. Cover with a coat of brown glaze.—E. L.

Two-Rail Operation

2. REVERSING-LOOP CONTROLS

By David Marshall

WE HAVE already seen some of the surprising results of two-rail operation. To recall but one, look at the single-track junction in Fig. 1. Remember that the frog is not insulated, but with the points, lead rails, and heel rails receives power from one or the other stock rail, depending on whether the switch is open or closed. Thus, in the upper sketch, the "gates" are closed, establishing the main route. But, what is to be noted carefully, the diverging route is dead, and the main route protected against fouling from the southwest.

In the lower sketch, the switch is open, and the diverging route is both established and protected, for the main route is dead.

ALIGNMENT LIGHTS. An even more surprising result is obtained by simply wiring red and green lights from rail to rail, as in Fig. 2. Here the lights appear as wayside signals protecting the junction from every approach; and this much can be said for them, that at least they will show infallibly how the switch is aligned (which is, of course, a primary function of interlocking signals). As identified in Fig. 2.

Signal No. 1 protects the main route from the rear.

Signal No. 2 protects the diverging route from the rear

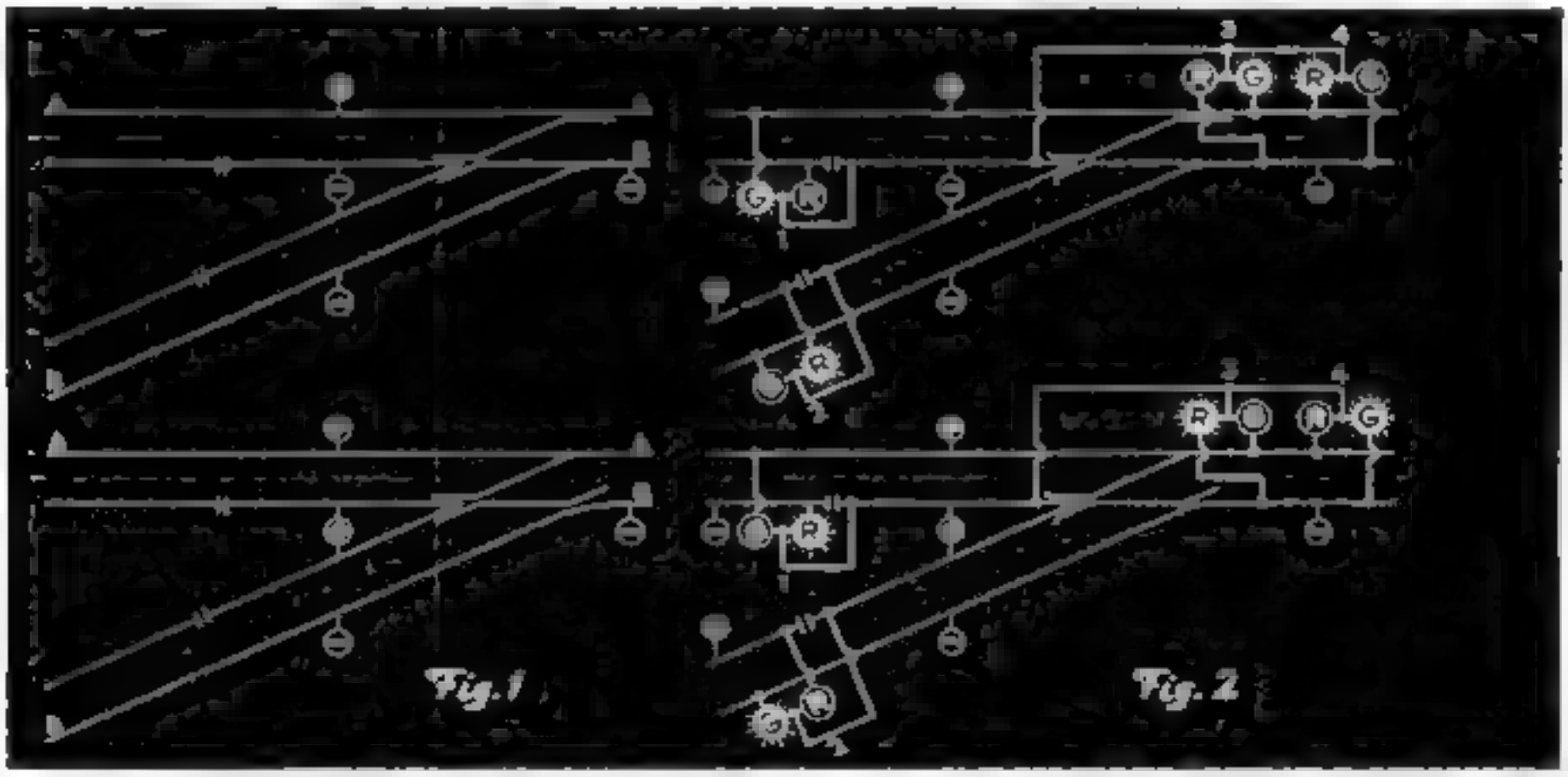
Signal No. 3 protects the entrance to the main route.

Signal No. 4 protects the entrance to the diverging route.

In accordance with standard railroad practice, signals No. 3 and No. 4 both appear on the same mast; but you must not forget that they are two separate and distinct signals, and that the upper one, No. 3, governs the main route always, while the lower one, No. 4, governs the diverging route always.

Obviously nobody operates these signals, but all four together change color automatically in response to the movement of the switch points. On the other hand, the signals serve two good purposes: they tell you at a glance the condition of the switch, whether open or shut, and they guarantee that the switch movement is in every instance accurate, for if the points begin to stray, the lights will all go dark. In addition, of course, the signals meet especially well our purely pictorial requirements.

But they are not, of course, automatic signals in the strict sense of the word. A green does not change to red as a train passes by, and a false indication is always present. Thus No. 1 and No. 3 can both show green at the same time, though these two signals conflict with each other, and the same is true of No. 2 and No. 4. These signals do not protect the trains, as auto-



matic signals do, but they give good service of the kind indicated, and they look grand.

CONTROL LIGHTS. Every wayside signal can be, and ought to be, repeated on your control board; and the alignment lights of Fig. 2 acquire an additional value if each is hooked up in parallel with a corresponding light on the panel set before your rheostats. What that new value is we can best realize if we turn to the reversing loop.

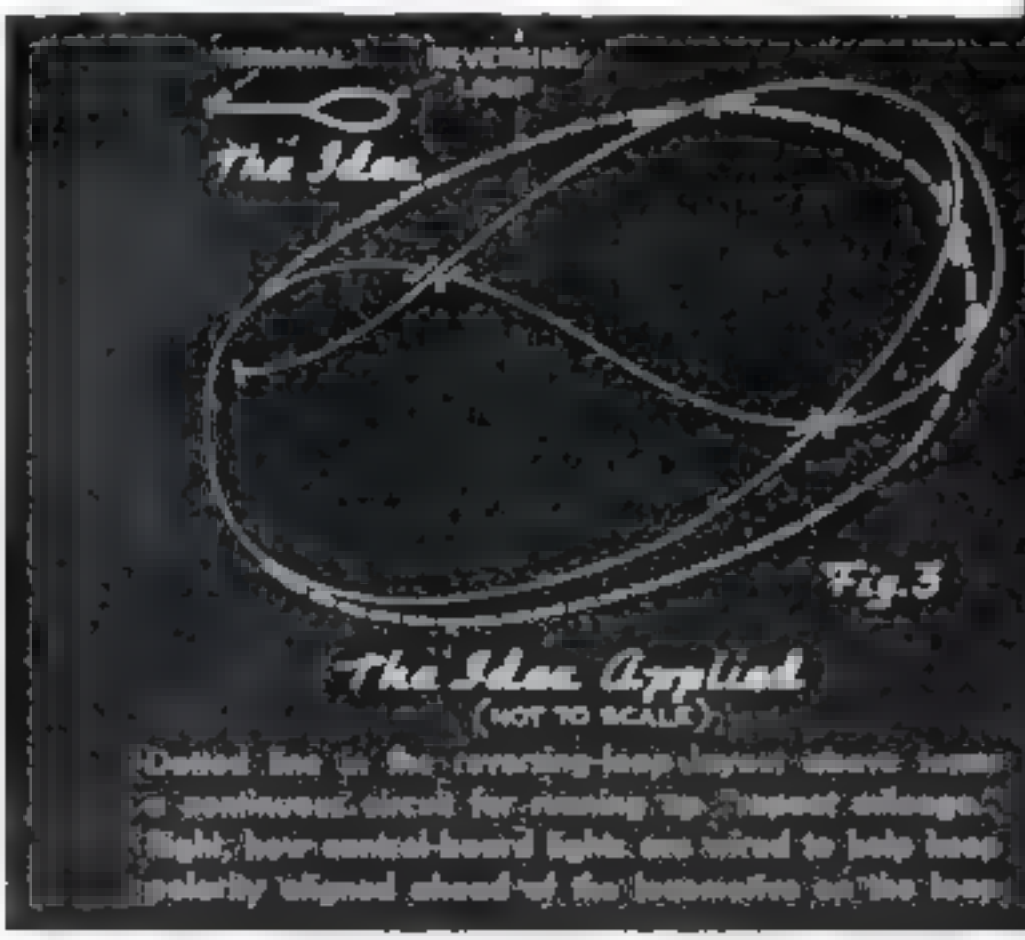
The tear-drop reversing loop (Fig. 3) is one of the most important elements of model-railway design. But on a two-rail pike, the reversing loop presents one special problem, which is made plain in Fig. 4. The point is that while a train is making her transit of the loop, the polarity at the junction must be reversed without permitting this reversal to affect the train.

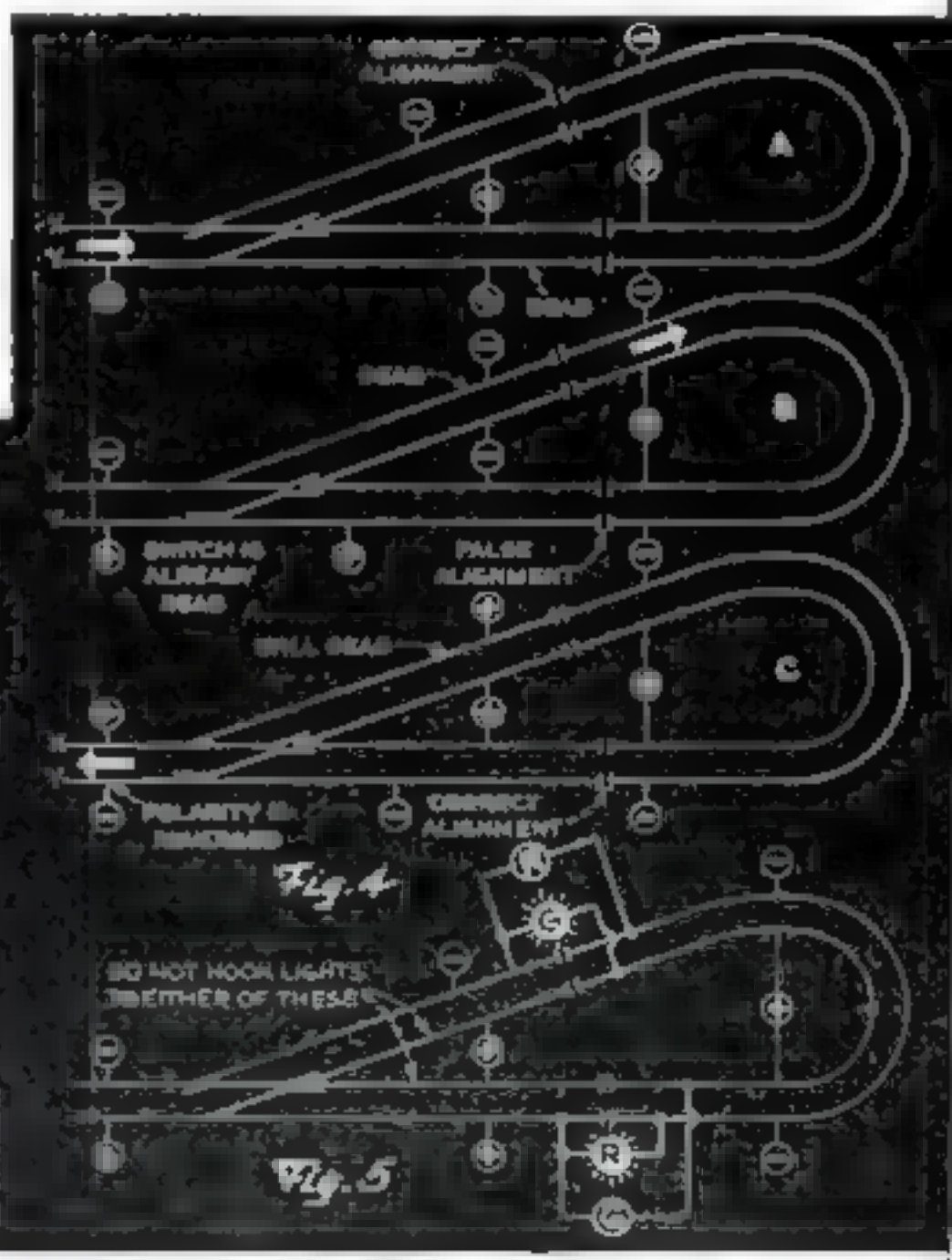
In *A*, for example, the train, about to enter the loop, is receiving power from the *Y* rail, returning it through the *X* rail. But in *C*, on emerging from the loop, she draws power from *X*, returns it through the *Y* rail. And while she is still in the insulated middle section of the loop, you must anticipate her emergence not only by changing the condition of the switch, but by reversing both the switch and the polarity of the rails. The flow of electricity must be from the right-hand drivers to the motor, and from the motor to the left-hand wheels of the tender, as in using direct current and locomotives equipped for polarized reversing. (As a matter of fact, we are not committed to direct current or to polarized reversing; but we design the pike as if we were, and thus avoid trouble. We can then use either D.C. or A.C., and either polarized or sequence reversing. With any other design, short circuits will occur and the sequence reverser will frequently be actuated by unintended power lapses.)

And so our special problem, with a two-rail reversing loop, is to keep the polarity properly aligned in advance of each moving train. And in meeting this problem, we can profit immensely if we apply to the whole loop, including the junction, the alignment lights illustrated in Fig. 2.

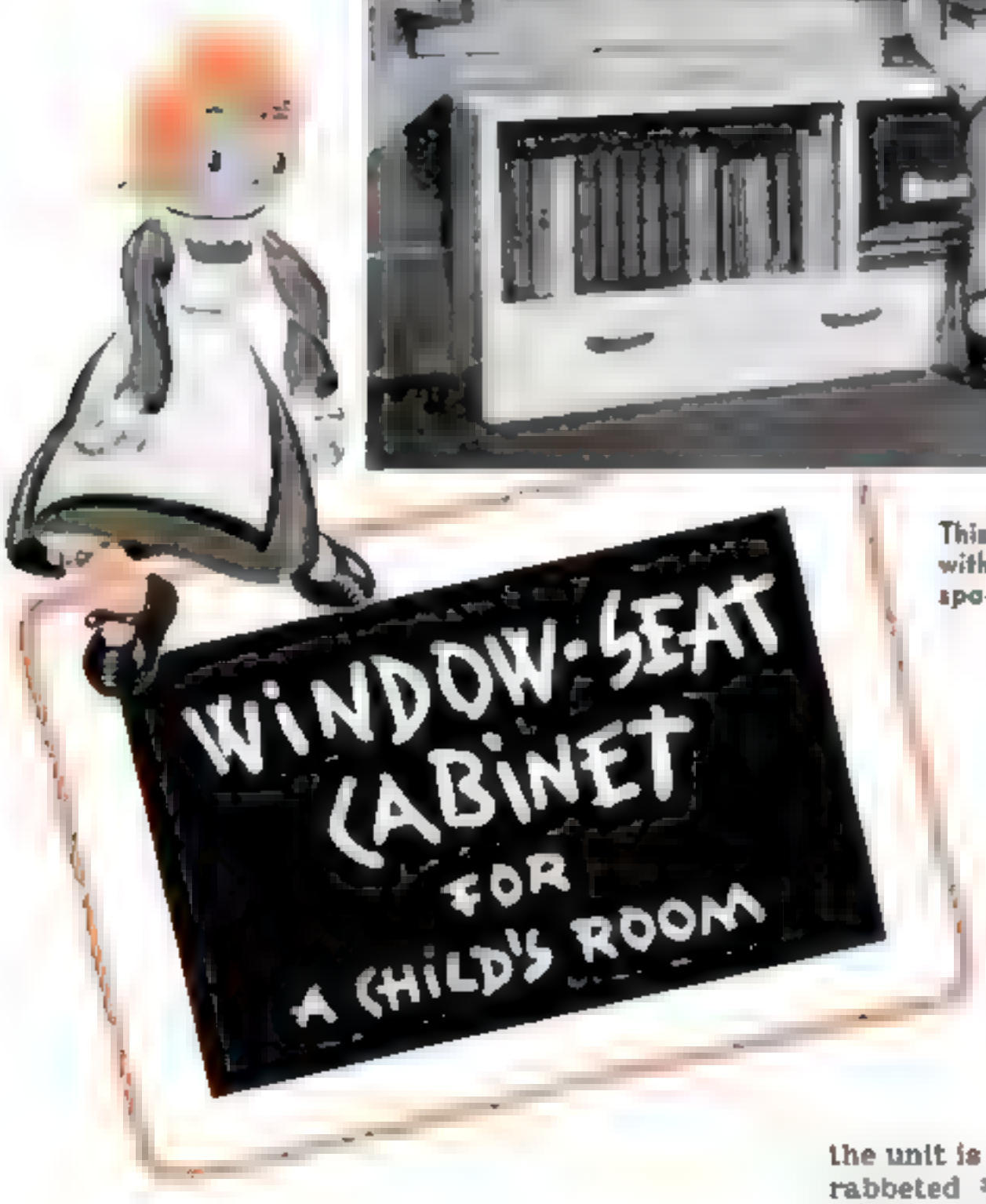
LINING UP THE TRACK. Instead of using these for wayside signals, let's place each pair in its proper place upon the board. The board, of course, contains a painted diagram of your pike, and the lights are set up at points corresponding to the insulated rail joints. They are not signal lights, but they tell you when to throw your double-pole double-throw switches—one for the main line and one for the insulated loop segment—to keep the polarity correctly aligned. When you finally signal your pike, these lights will not be displaced but will continue to serve their important purpose.

The hookup and the board routine are both made clear in Fig. 5. As the train moves forward, you must be certain that the alignment light is green well before she arrives at the end of an insulated section—otherwise she'll kick up fireworks.





This "grown-up" unit provides a child with generous book, cabinet, and drawer space combined with a seat by the window



By THOMAS PARTRIDGE

THE cabinets, drawers, and bookcases that parents use are often looked upon with envy by the children of the family. This four-in-one unit more than satisfies the youngster's desire for "grown-up" furniture. It combines adequate book space, a cabinet "with real doors," three convenient drawers, and a window seat. Craftsmen will be particularly interested in the way its construction solves many of the problems encountered in building modern "unit" pieces.

White pine and fir plywood were used, and finished with enamel. If a varnish or other transparent finish is to be used, red gum or some other cabinet wood may be preferred. The white pine required consists of: 25' of ¾" by 10", 14' of ⅓" by 4", 6' of 2" by 2". Two panels of fir plywood are needed, one ⅛" by 48" by 48", and one ¾" by 24" by 28".

Attractive drawer handles can be obtained at a hardware store. The cabinet handle is turned from a disk of bird's-eye maple or other wood, 1" thick and 7" in diameter, to the profile in the drawings, and sawed in half. Bullet catches hold the doors.

The floor rail for the front of the unit is made from the 2" by 2" stock and rabbeted ¾" by 1½" its full length to receive the front edge of the lowest shelf or floor. How these pieces fit together is shown in the drawings. As a further bearing for the lower shelf, a 1½" thick cross member is attached to the center of the shelf at right angles to the rail.

The first step in making the drawers consists of ripping the ½" wood to a width that slides into the drawer cases easily, after which the ¼" by ¼" dado cut for the drawer bottom is made ¼" from one edge. Then the boards are cut to the various lengths required

For making the stepped dado joint at the ends of the drawer front on a circular saw, the jig shown in the drawings will be helpful. Two ¼" bolts 3" long are used to clamp the work. They should be fitted with wing heads for easy hand operation. Holes are drilled through the washers at the back of the jig, and small screws are run in to hold

Using a jig for cutting a dado for a drawer-front end joint. The work is clamped vertically in the jig, which is then slid against the saw rip fence

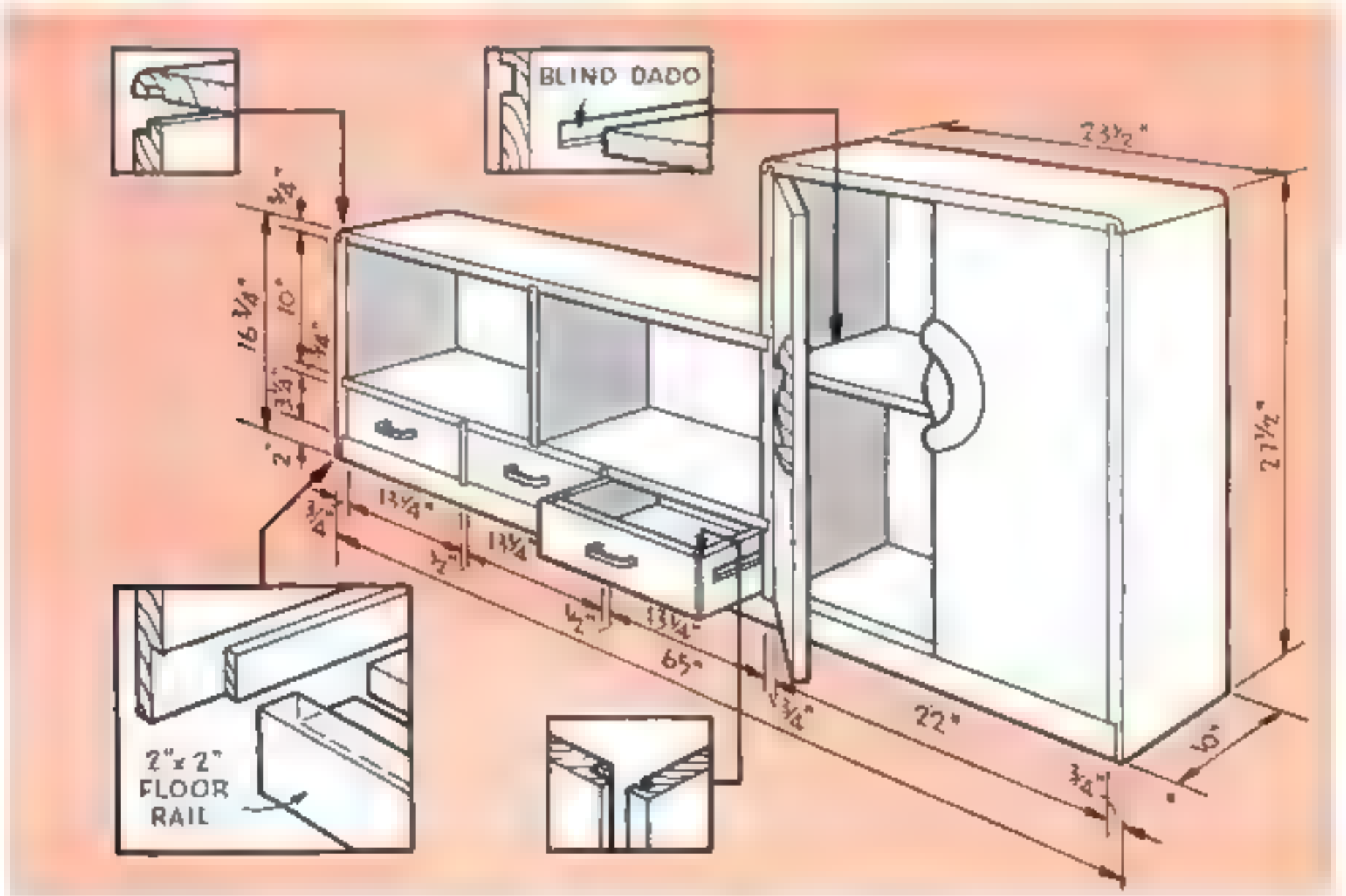
the bolt nuts in place. The board to be cut is placed vertically between the clamping strip and the face of the jig, and snugly against the strip near the front bolt. In use, the jig is slid against the saw rip fence, as shown in one of the photographs.

Both drawer dividers, as well as the end and one cabinet wall, should be provided with strips of wood to engage the dado cuts in the drawer sides with an easy sliding fit. Allow a little play in fitting the drawers so that they will not be too tight after the finish has been applied. Avoid using paint where there is friction caused by the opening or closing of the drawer. Use a good wood sealer instead, rub down until smooth with fine steel wool, and then apply several coats of wax, rubbing well.

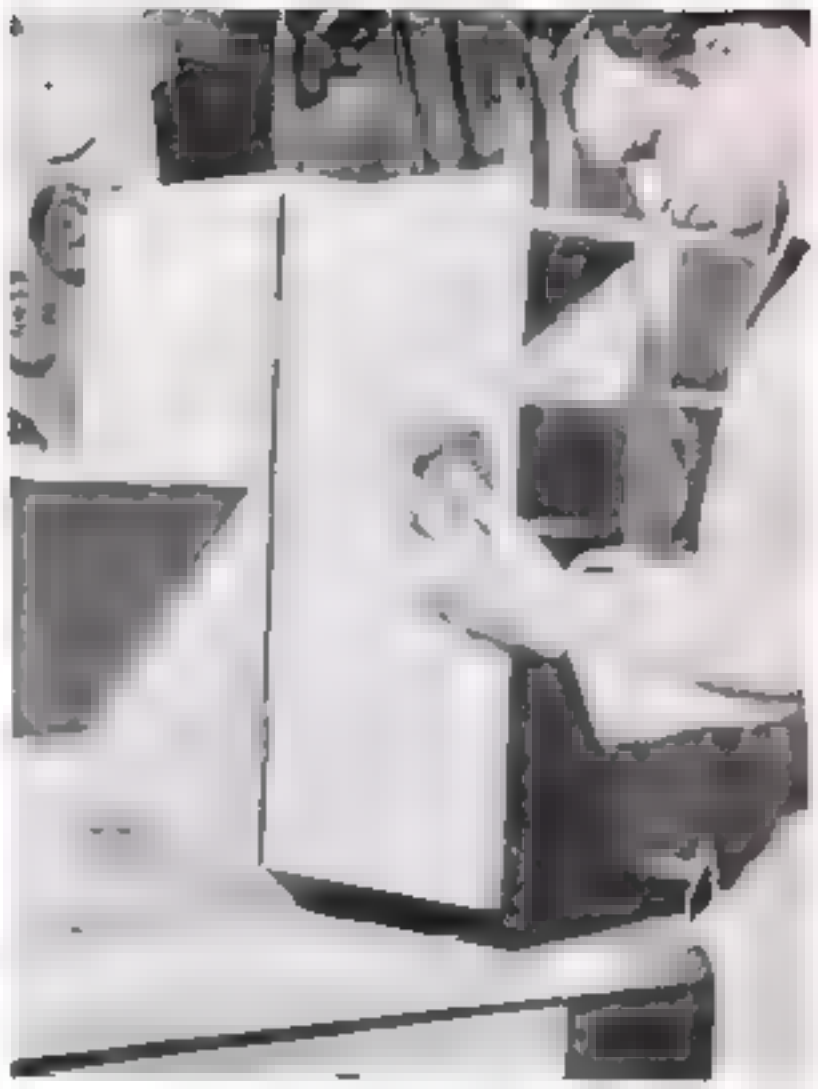
If a transparent finish is to be used and the joints have been made with care, the unit should be assembled only with a good grade of glue for all exposed joints, although the back may be attached with screws. If an enamel finish is used, however, all the joints may be reinforced with screws, in addition to glue. They should be countersunk well below the surface and the holes filled with plastic composition wood. Leave little mounds of the plastic material over the holes, and allow at least 48 hours before sanding off the excess. Sand well all over before applying the first undercoat.

On the original piece, the inside, or central portion, of the knob was finished with three

Measurements in the drawing are for an average room, but may be changed slightly to suit space. The corner construction is detailed in the insets



coats of brilliant red enamel to match the red drawer handles used. The entire knob was then given five coats of a good grade of spar varnish, rubbed down with pumice and water, and finally with rottenstone and oil. This gives a semidull, glass-smooth finish that is very attractive and stands up well.

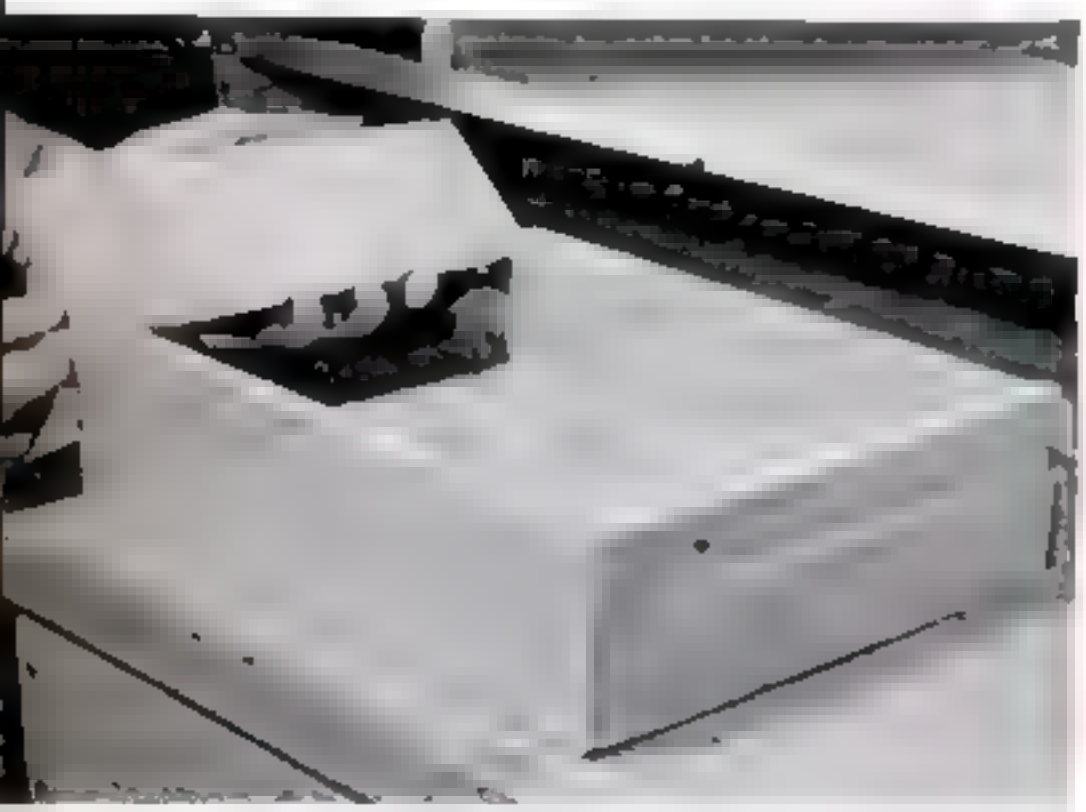


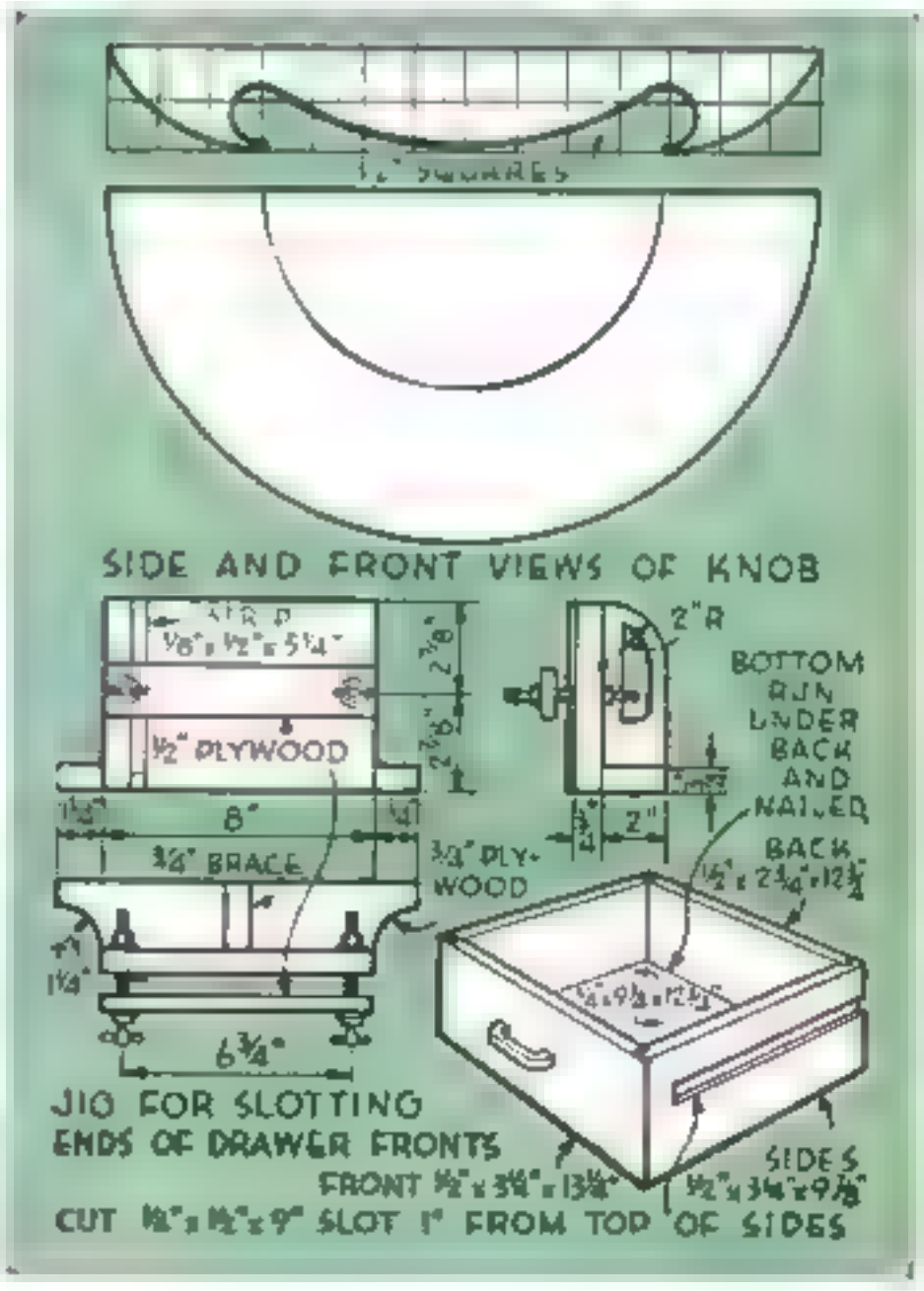
One of the attractive modern touches is the door knob, which is turned as shown below, then sawed in two. Each half is fixed permanently to a door. Bullet catches hold the door closed

Make the joints carefully so that those exposed may be assembled only with glue if the finish is to be transparent. Reinforcing screws may be used under enamel, and are good on the back in any case

At right are drawings of the jig used in slotting the drawer-front ends, details for building the drawers, and two views of the cabinet-door knob

Drawers should be assembled with tight and square joints. Use no paint where there will be friction

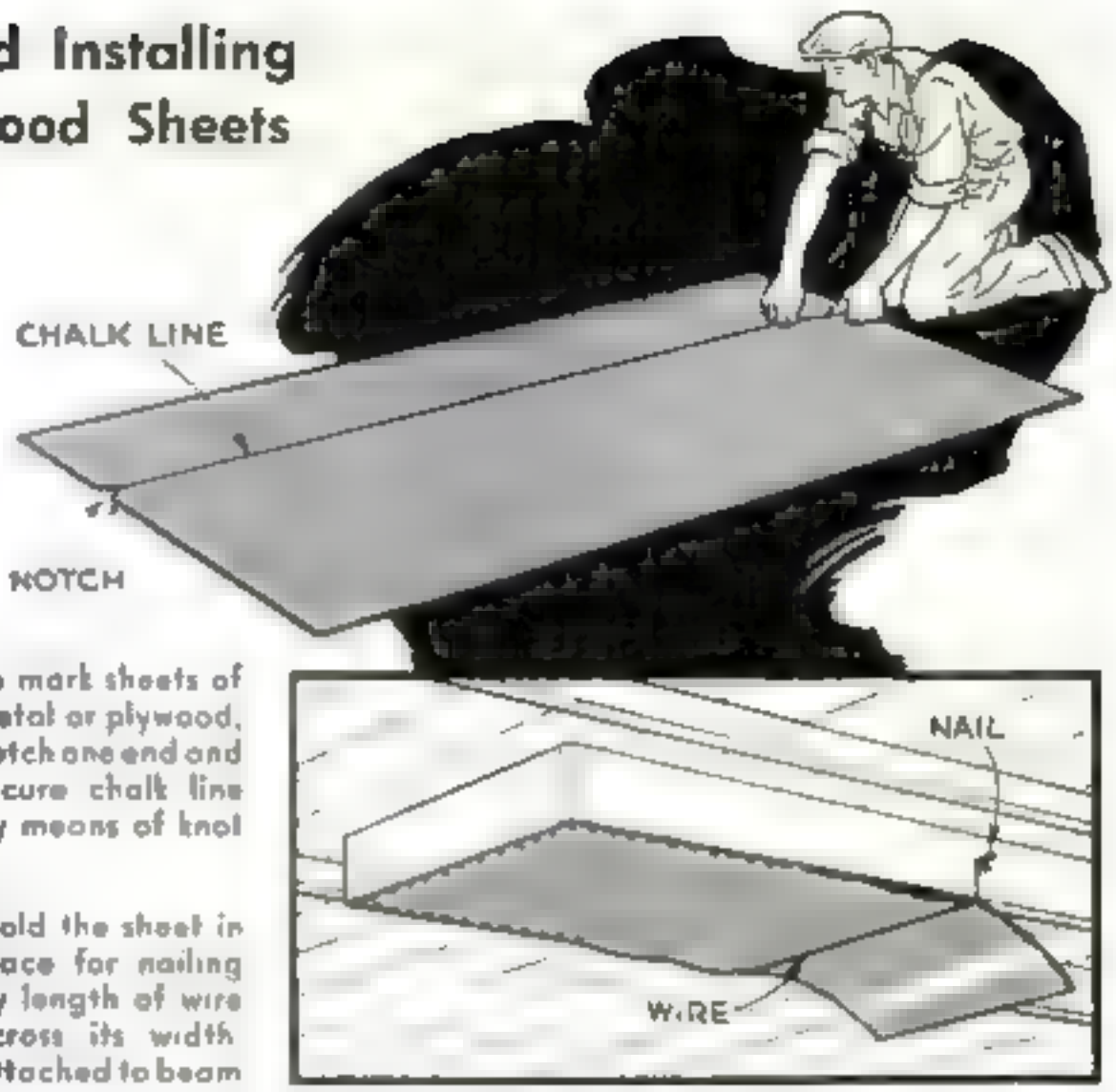




Aids in Cutting and Installing Big Metal or Plywood Sheets

IF YOU have to mark a long piece of sheet metal or plywood for cutting to width, you can save time by notching the sheet at one end and running a chalk line through the notch. A knot at the end of the line keeps it from pulling out.

Installing cold-air boxes for furnaces is a hard one-man job when cumbersome iron sheets have to be handled. The same goes for applying wall board or plywood when the installation is overhead. It is easier to hold the sheet in place while nailing if one end is supported with a length of wire attached to two nails, as shown.—R. S. WILKES.



To mark sheets of metal or plywood, notch one end and secure chalk line by means of knot

Hold the sheet in place for nailing by length of wire across its width attached to beam

Small Comb Carried in Sheath Attached to Eyeglass Case

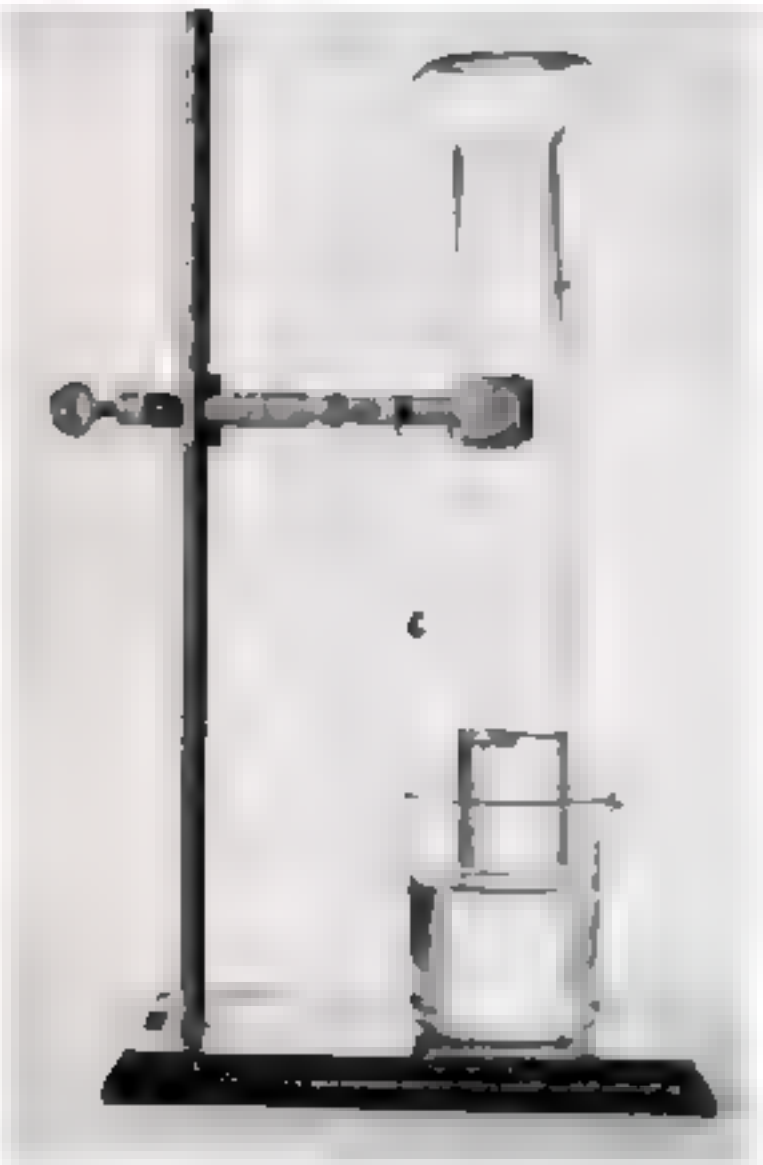
ANYONE who carries an eyeglass case will find it simple to add a sheath or pocket for a comb. Make it of a leather or artificial-leather strip to match, and cement the edges firmly to the back of the case.—H. R.

• • •

NAILS hold better in plywood than in solid lumber, as plywood resists the tendency of a nail to split the fibers apart.

REMOVING PAINT FROM GLASS [*PAINTING*]

PAINT can be removed from window panes, show windows, and other glass as follows: Make up a paste of 1 lb. of whiting and a small quantity of water containing all the washing soda it will dissolve. Apply this paste to the paint, such as, for example, painted letters on a show window which it is desired to remove or replace with other lettering. Leave the paste on until the letters are soft and can be cleaned off with a wad or roll of newspaper. This method puts the window in good shape for lettering again. As an additional precaution, however, wipe the area with a clean cloth and denatured alcohol.



Phosphorus burning on a floating cork uses oxygen in air in the hydrometer jar, above, leaving nitrogen and traces of other gases

Pure nitrogen may be produced by gently heating sodium nitrite and ammonium chloride in water, and bubbling the nitrogen gas up through water into an inverted test tube

THE UNFRIENDLY ELEMENT

Nitrogen, So Common in Nature, Will Often Fight to Be Alone

LAZY nitrogen likes to be alone. One of the most familiar substances on earth, it is also one of the most sluggish. Try to join free nitrogen with some other element, and you need the help of artificial lightning or expensive catalysts. Even then, an incautious touch, a rise in temperature, and "Boom!"—your nitrogen has blown up its compound (if not apparatus and laboratory) in its desire to be free.

Nitrogen makes up 78 per cent of the air. You may show the proportion with the aid of a piece

At left, nitrates form a brown layer when treated carefully with ferrous sulphate and sulphuric acid. Center, ammonia gas can be collected in an inverted flask by heating ammonia water. Right, ammonia gas is so soluble it sucks water rapidly into the flask

of phosphorus half the size of a pea on a slice of cork floated on water. Light the phosphorus, and invert a hydrometer jar over it. Clouds of phosphorus pentoxide will fill the tube, and water will rise in it until the oxygen is consumed. When the smoke dissolves, nitrogen and traces of other inert gases remain.

It is so difficult to remove these other gases that pure nitrogen is generally produced by heating a chemical mixture. Into a 250-cc. flask put 7 gm. sodium nitrite and 5 gm. ammonium chloride. Through a thistle tube add add 50 cc. water. Arrange the flask with a delivery tube leading from it into a test tube full of water that has been inverted in a bowl also containing water.

Gently heat the chemicals, taking care not to overheat them, as a violent reaction might burst the flask. Heat just enough to keep gas bubbling slowly. If the mixture froths, remove the flame and pour a little water through the thistle tube. Once the reaction has started, it may continue for some time without further heating.

Collect several bottles of the gas, which will have neither color nor odor. Put a lighted splint into one bottle and the flame will be extinguished.

Ammonia (NH_3) is one of the commonest compounds of nitrogen. You can prepare it by gently heating any ammonium compound, such as ammonium chloride or sulphate, with an active base, such as lye or slaked lime. Small quantities may be obtained by heating household ammonia, a solution of ammonia gas in water. The gas is little more than half as heavy as air, and

Ammonia and air drawn over hot copper form nitric oxide, and then a dioxide, which bubbles in water to make nitric acid. The bottle at right is a siphon

Mix a small quantity of ammonium nitrate with zinc dust on the cover of a can, and carefully add a little water. The mixture will bubble and smoke, then burst into flame, as at left. This experiment is harmless, but shows the violent instability of many of the compounds of nitrogen

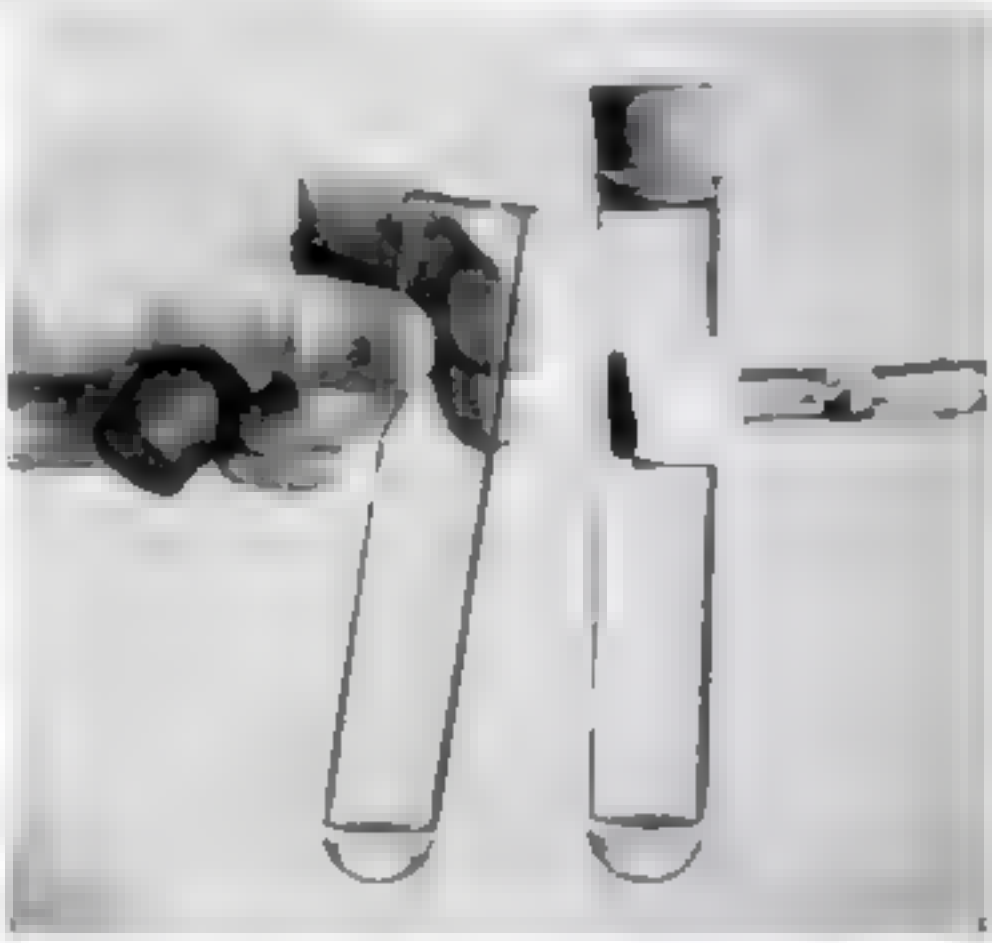
Below, nitric oxide (in the tube at right) is a colorless gas, insoluble in water. Exposed to air (left), it changes to dense brown nitrogen dioxide, and this gas, shaken in a tube with water, combines with it to form weak nitric acid

so can be collected by upward displacement.

Ammonia is so soluble that more than 600 volumes of it will dissolve in one of water. Invert a flask on a ring stand, and fill it with ammonia gas until the odor of escaping ammonia is detected. Close the flask with a stopper containing a glass tube, the upper end of which has been drawn out to a jet in which are several drops of water. Insert the other end of the tube into a beaker of water containing a little phenolphthalein solution. The ammonia dissolves in the drops in the tube, creating a partial vacuum, which in turn sucks water from the beaker. Ammonia is alkaline, and turns the phenolphthalein red as it enters the flask.

Compounds that contain nitrogen in the form of nitrates may be detected by a simple test. To a strong solution of freshly prepared ferrous sulphate add a little of the solution to be tested. Tilt the test tube, and carefully pour in a little concentrated sulphuric acid, letting the acid run down the side and form a layer in the bottom. If a nitrate, even in minute quantity, is present, a distinct brown ring will form between the acid and the solution.

Nitric acid (HNO_3) may be made by suspending a wad of cotton wool, saturated with strong ammonium hydroxide, at the end of a horizontal tube of hard glass, loosely filled with strands of thin copper wire. Heat the copper quite hot by a flame spread out by a wing top on a Bunsen burner so that a mixture of air and ammonia will be drawn through the tube, and bubbled through water in a flask, with suction provided by



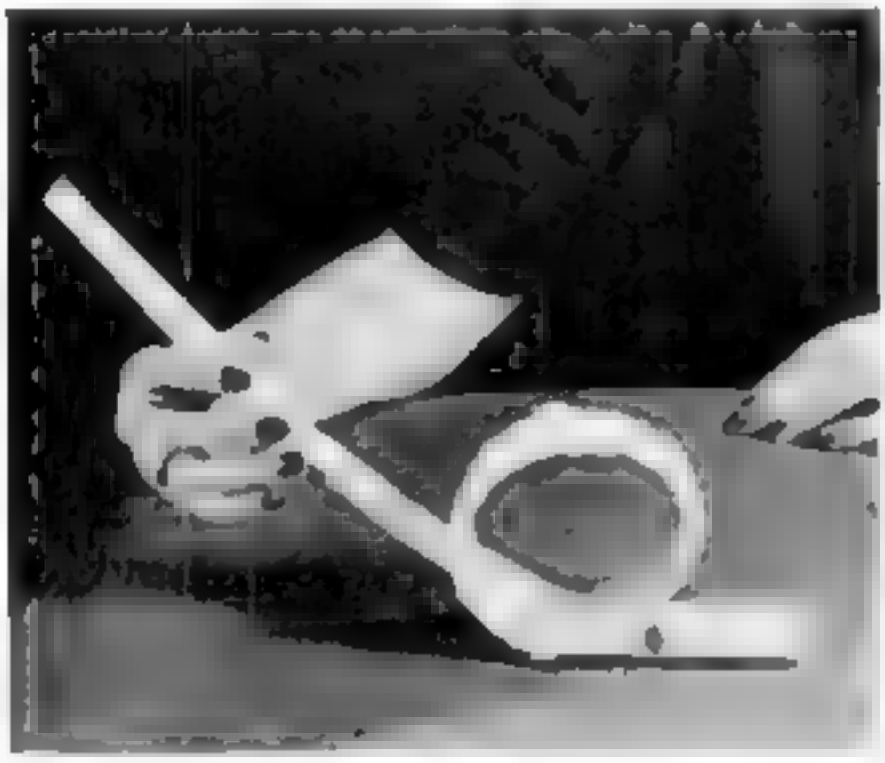
a siphon bottle. A pinch clamp on a rubber tube between the flask and bottle will limit the flow to two or three bubbles a second. Ammonia and oxygen unite on the surface of the heated wires to form nitric oxide and then nitrogen dioxide. Weak nitric acid is formed by bubbling the nitrogen dioxide through water.

A harmless experiment demonstrates the violence with which nitrogen often frees itself from compounds. Mix a few grains of ammonium nitrate and zinc dust on a can cover, and then, being sure that you do it cautiously, add a few drops of water. The mixture will bubble, smoke, and burst into flame.—KENNETH M. SWEZEY.

Centrifugal Force and Sound Vibration Demonstrated in Simple Tests

home EXPERIMENTS

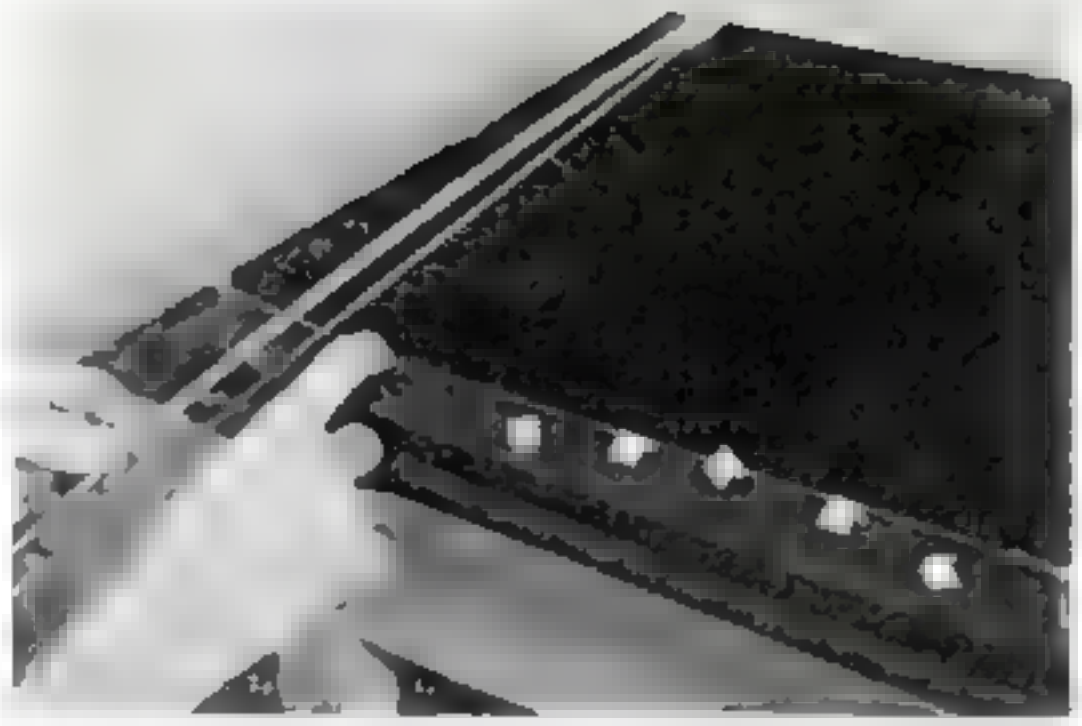
TABLE-TOP demonstrations provide an entertaining way to investigate the apparent mysteries of science and amuse your friends at the same time. Here are half a dozen simple experiments dealing with as many oddities of science. Four of them show the application of centrifugal force—in amusement-park loop-the-loop rides, in the banked curves of railroad tracks and automobile highways, in the operation of the centrifuge for settling solids precipitated in solutions, and in explaining why the earth is flattened at the poles and bulged at the equator. One test exposes the roar in sea shells, and another presents a visual illustration of the overtones of stringed musical instruments. All can be performed with no more space than the top of a card table, and none requires equipment other than that ordinarily found in the average home.



CARNIVAL LOOP-THE-LOOP DEVICES and motorcycle "death rides" are explained by a demonstration with a strip of cardboard and a marble. Loop the cardboard, as above, and fasten the loop with paper clips, then let the marble roll down the incline. If the speed is great enough, the marble will shoot up and around the loop; if not, it will fall. It's a battle between centrifugal force and gravity.

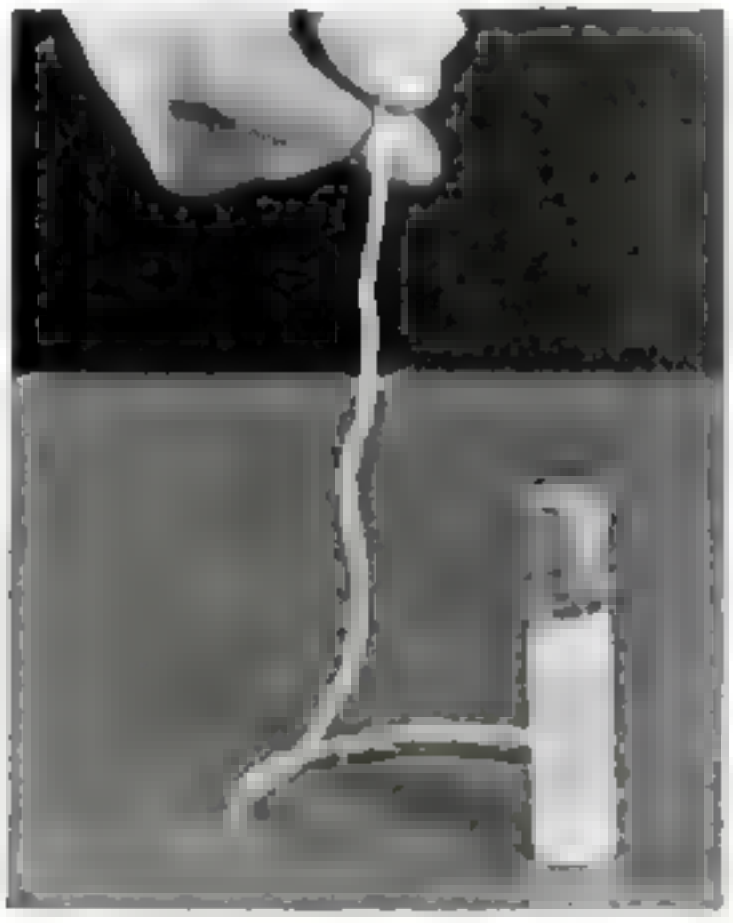
RAILROAD TRACKS AND HIGHWAYS are banked at curves to combat centrifugal force and keep vehicles using them from tending to skid off into a straight line. Give a marble "car" energy of motion by letting it roll down a rather steep cardboard "hill" with a curve at the bottom, as shown above. The marble will follow the turned-up edge of the cardboard around the curve, and run off at a tangent at the end.

SOUNDS IN SEA SHELLS are not the stored-up roar of the sea, but are picked up from the jumble of sounds in the air and correspond to the natural rate of vibration of the air within the shell. Air within any inclosed space vibrates at one particular rate, or pitch, more easily than at any other, and when mixed sounds are impressed upon the space, the sound corresponding to the natural pitch of that space is singled out and amplified. Jars, tumblers, and cans have this quality as well as sea shells. Listen to a few of different sizes. The sound will be different for each, the pitch getting higher as the size of the space decreases.



home EXPERIMENTS

OVERTONES OCCUR WHEN A WIRE VIBRATES as a whole and in segments at the same time. Stretch a thin wire between two nails, and space folded paper riders on it, as marked in the diagram. Using a finger as a stop, touch the wire with the rosined string of a homemade bow, as shown. The vibration will throw off Nos. 1, 3, and 5, while 2 and 4, the nodes, remain.



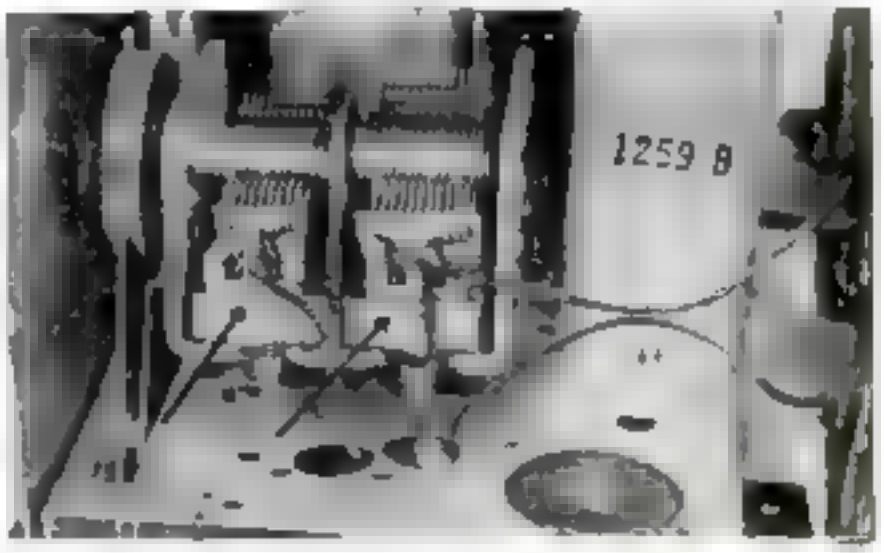
MAKE YOUR OWN CENTRIFUGE by tying a short length of cord around the neck of a pill bottle containing precipitated chalk and water. Shake up the chalk, then whirl the bottle in a horizontal plane for a full minute, gradually decreasing the speed at the end. When you stop, most of the chalk will have settled in the bottom —much quicker than it would had it been left quiet. Electrical centrifuges are used to settle solids quickly in chemical research, and a similar device is used in separating milk from cream.

WHY THE EARTH IS FLATTENED AT THE POLES may be explained with a hand drill, two cardboard hoops, and a curtain rod. Arrange the hoops as a sphere with the curtain rod as an axis, leaving the upper part of the hoops free to move up or down, and clamp the rod in the drill. As you spin them, the hoops will flatten at the axis and bulge at the outer points—more pronounced the faster you spin the handle. Many scientists say that millions of years ago, when the earth's mass was hot and plastic, the rapid rotation of the earth caused its surface to bulge along the equator, and to become flattened at the poles.

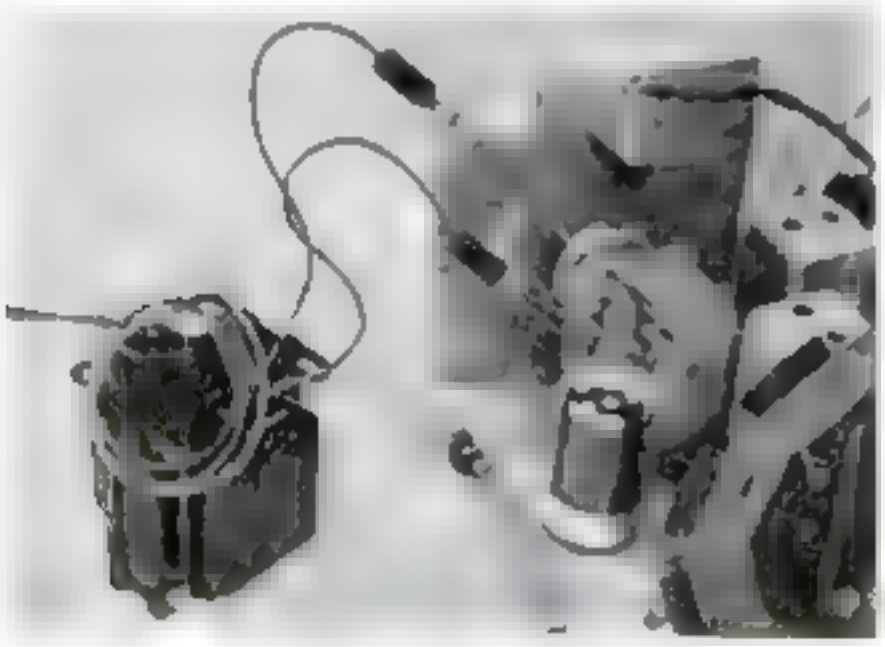
Servicing Your Radio— PART 10

OFTEN minor adjustments that can be made at home will correct radio-receiver difficulties or give additional reception to an old set. Below are methods for detecting a faulty heater in the power pentode tube, extending reception at the upper end of the dial, eliminating noise in a new condenser, altering a midget filter circuit.

REPLACE THE POWER PENTODE TUBE if the pilot light goes on and then immediately goes off again each time the receiver is turned on. The trouble is a faulty heater in the 50L6GT tube. It makes proper connection inside the tube when cold, but when it warms up the contact is broken.

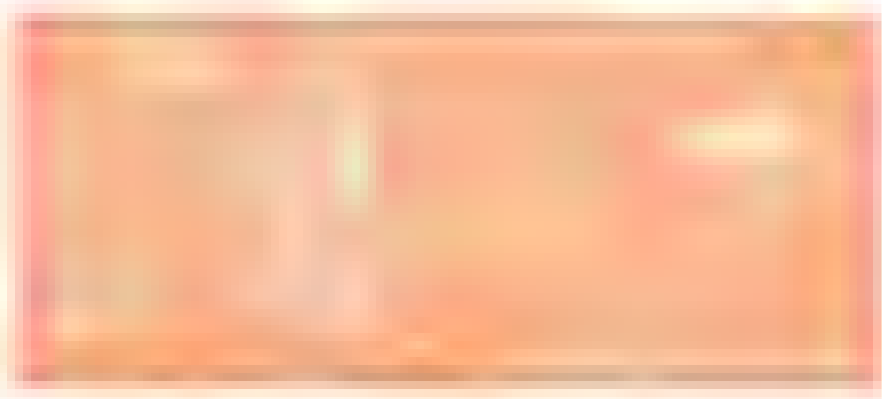


1,600-KC. STATIONS CAN BE BROUGHT IN on an old AC-DC midget set by readjusting the trimmer on the oscillator tuning condenser. The capacity is reduced a sixteenth of a turn at a time by loosening the nut shown at left above. Then loosen the nut on the other condenser to increase volume.



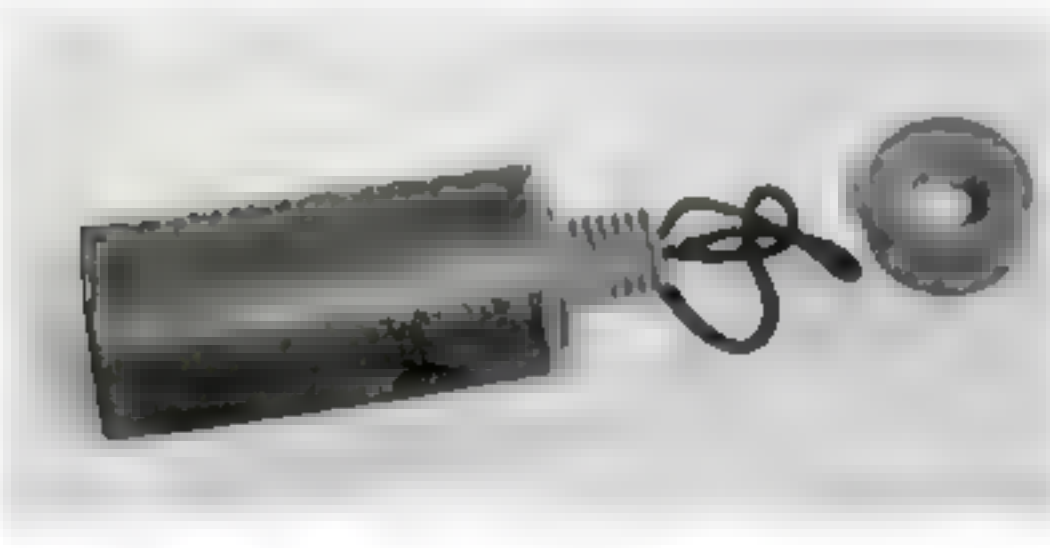
NOISY TUNING IN THE LATEST RADIOS may be caused by filings between plates of the oscillator tuning condenser. These may be burned out by connecting the secondary of a 700-volt power transformer across the condenser, as shown above and in the diagram. Be sure to disconnect the house current and the grid connection to the oscillator unit.

THIS SIMPLIFIED FILTER CIRCUIT for a midget AC-DC receiver uses only one electrolytic condenser, and may prove worth substituting when servicing a filter circuit that contains two or more electrolytic condensers if replacements for these condensers are hard to obtain. The diagram below shows how the substitute wiring is done.

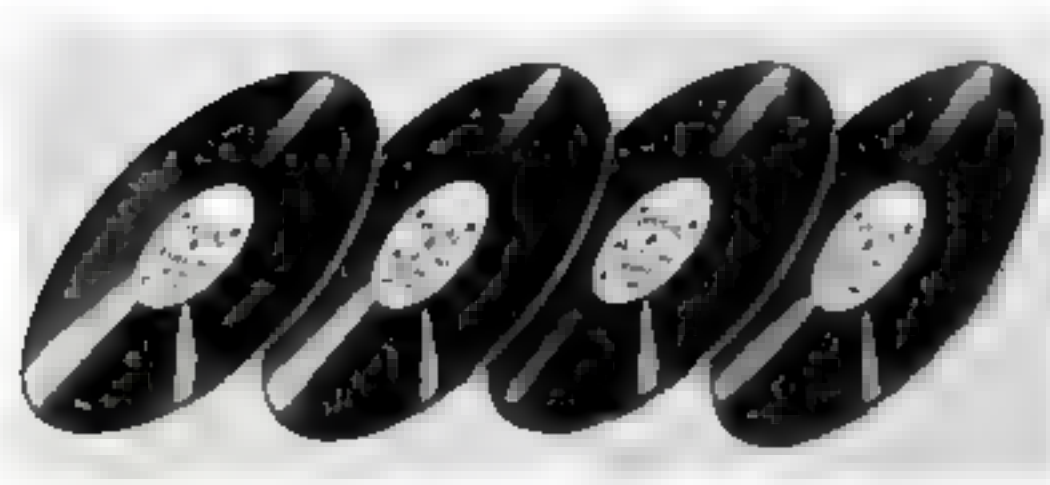


Radio Ideas

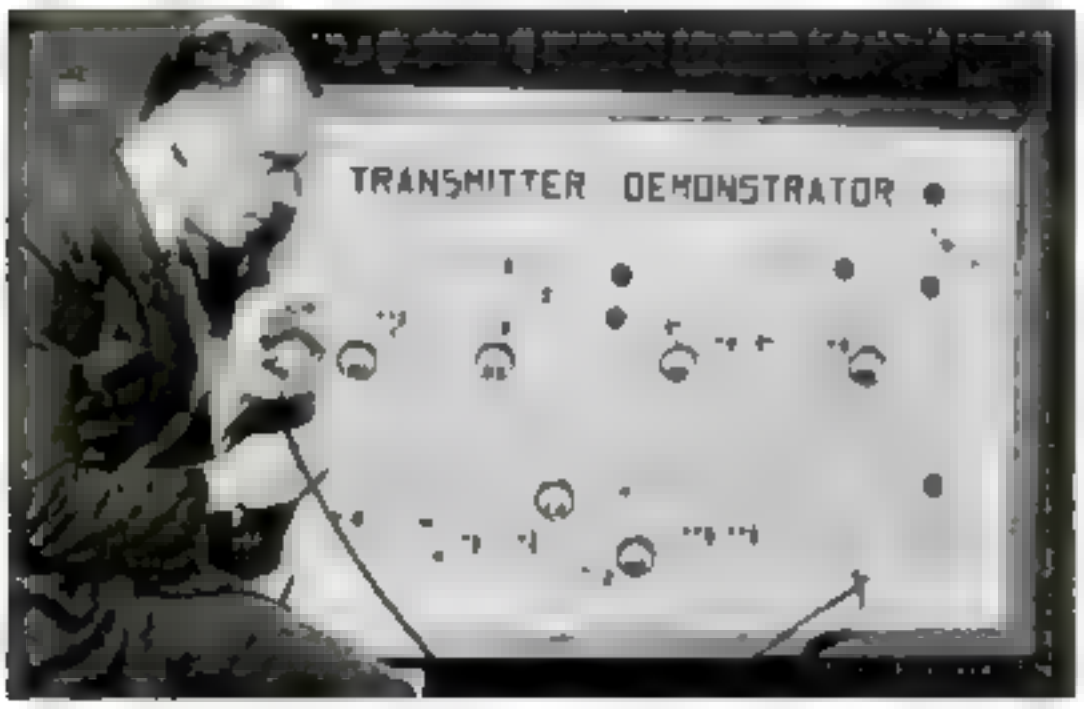
PARALLEL CLAMPS WITH "DOUBLE" JAWS are now on the market for metal workers and radio craftsmen. The double-jaw feature provides a better and firmer grip on the work than the standard-type parallel clamp with only one jaw, extending the usual gripping area of only ½" or ¾" to more than 2". The new clamps are constructed of steel, and finished with black wrinkle enamel to guard against rusting. One is shown in the photo at right, where it is being used to clamp two plates held in a vise.



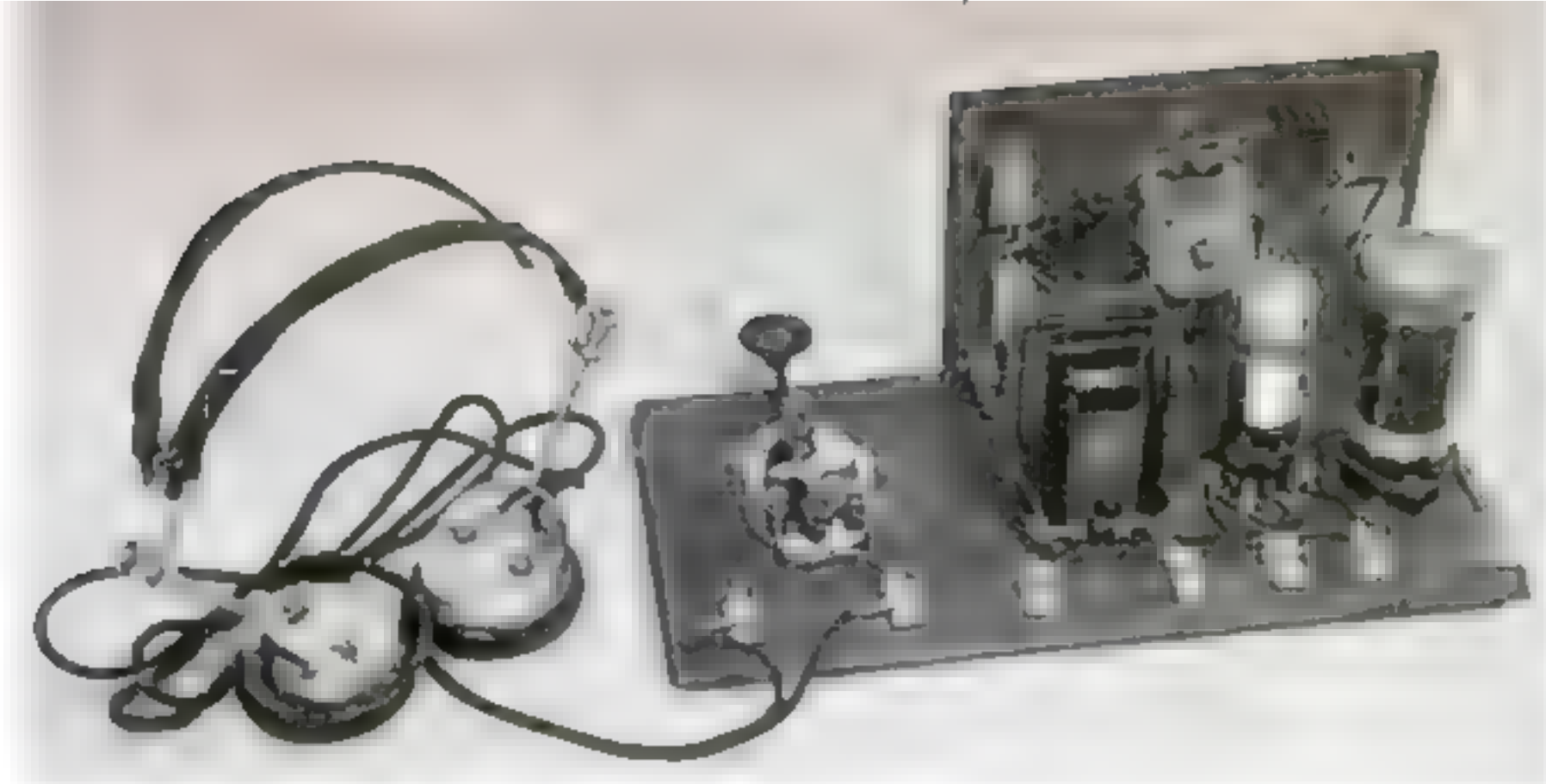
WOODEN ELECTROLYTIC CONDENSERS, employing an impregnated-cardboard tube container and threaded wooden neck, have been found a satisfactory substitute for aluminum threaded-neck condensers of either the wet or dry electrolytic type. They have the same mounting conveniences, and can be used in replacing defective wet capacitors in 90 percent of the radios now in service.



CHIME RECORDINGS for reproduction from church steeples have been improved to eliminate apparent discords arising from notes following too closely upon each other. In the new series, which contains 116 religious and patriotic selections, the recorded striking of the chimes has been acoustically timed and retains the musical relationship of the notes.



THIS TRANSMITTER DEMONSTRATOR—a schematic diagram of a radiotelephone transmitter—is used for visual education in the United Air Lines' Boeing School of Aeronautics. It shows the conventional oscillator, radio-frequency amplifiers, and speech amplifier with plate modulation, each symbol in the circuit diagram representing an actual part mounted directly behind it on the opposite face of the panel. These parts are wired together as in the diagram and perform as in any radio transmitter.



This combination set enables the student to practice sending code and to hear how it sounds when sent

Practice Code Sender and Receiver

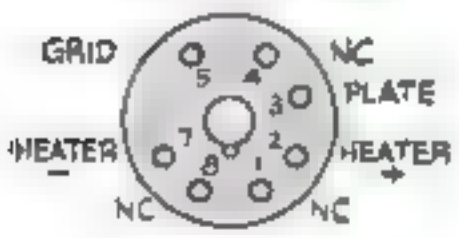
By ARTHUR C. MILLER

MANY thousands of young men and women are busily engaged in America learning international code either for civilian-defense purposes or in preparation for enlistment in the Signal Corps, and a code oscillator—though impossible to buy now—is fast becoming a standard item in many homes. Extra advantage for these students can be had with a combination radio receiver and code oscillator which will give them an opportunity to hear how the code they are practicing really sounds when sent over the air. This instrument changes over with the flick of a switch for operation either as a code oscillator for practice sending or as an all-wave radio receiver. It is used with earphones.

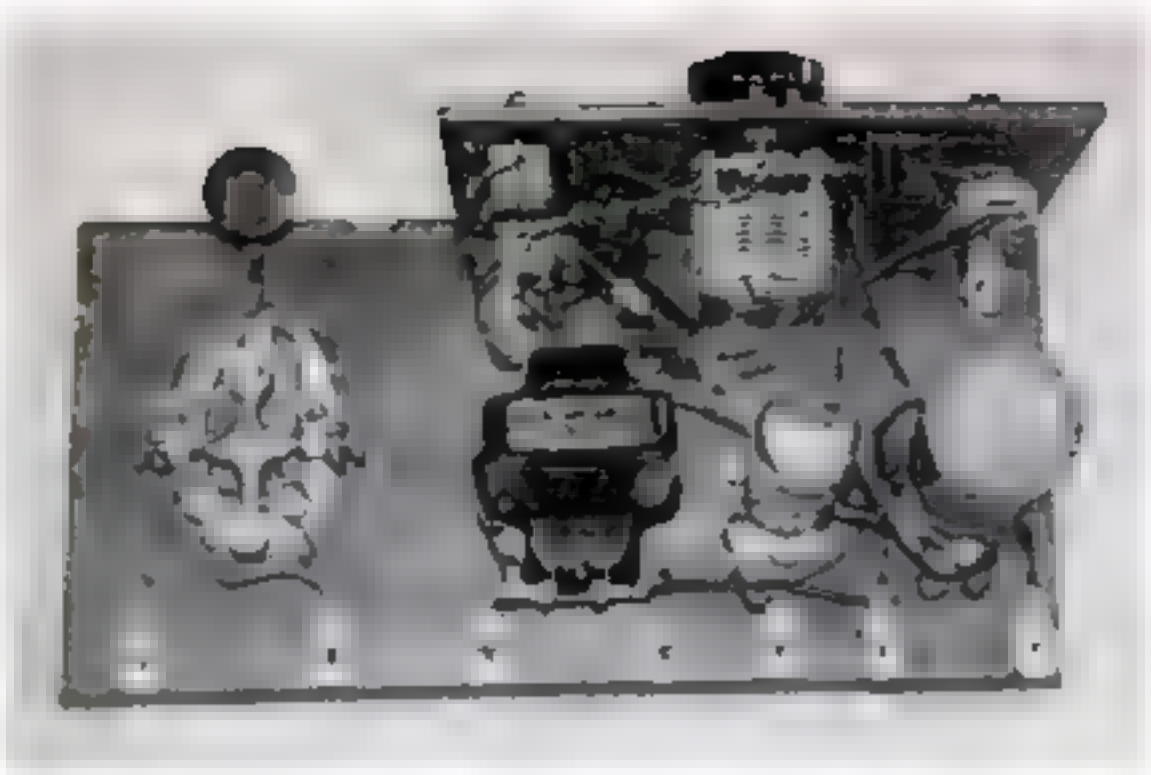
Obtain first a good 6" by 12" baseboard that will not warp and a piece of composition wood from which a 5" by 7" panel can be cut. The baseboard can be sawed out and glued up in the home workshop, or a small biscuit or pastry board that will serve excellently can be purchased for a few cents in one of the 10-cent stores. Both pieces should be given a varnish finish before any of the parts are mounted—a coat or two of walnut or other varnish stain for the base, and one or two of black wrinkle varnish for the panel.

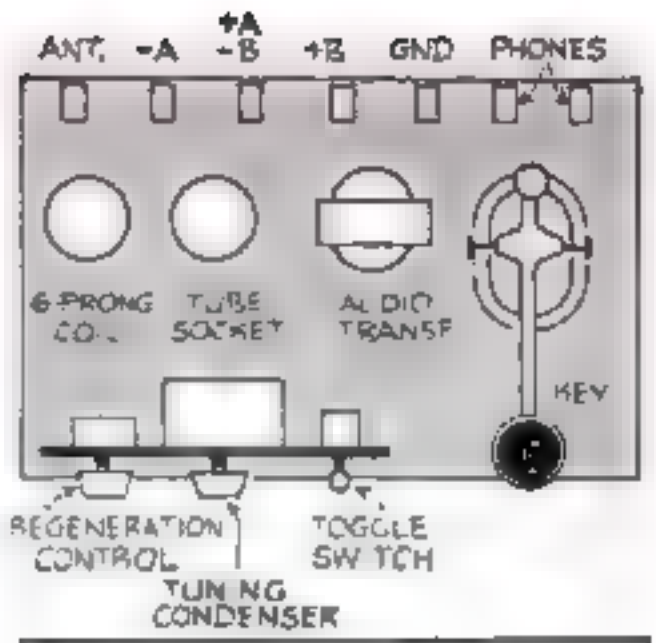
On the panel are mounted a .00014-mfd.

Complete wiring diagram for a code oscillator and radio receiver. All connections should be carefully traced in the diagram before doing the wiring. Below, the six-prong coil base

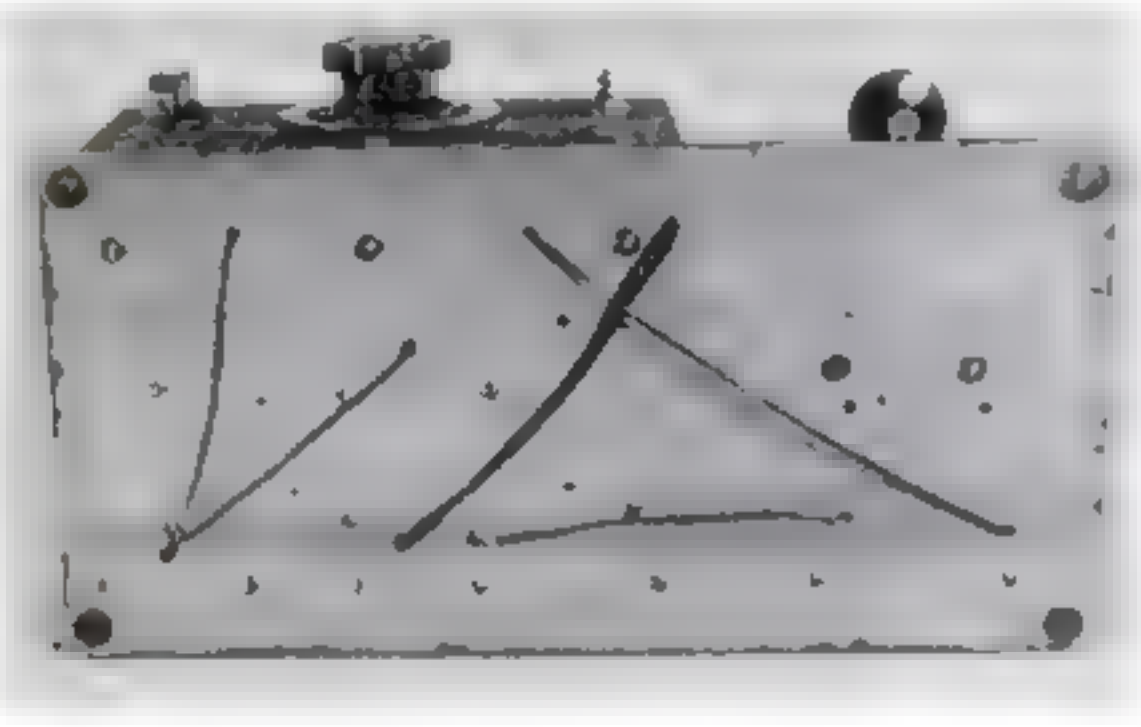


HW 575





All parts have been mounted and connections made in this view of the top of the baseboard and rear of the panel. Below, the bottom view of the baseboard shows some of the simplified wiring



LIST OF PARTS

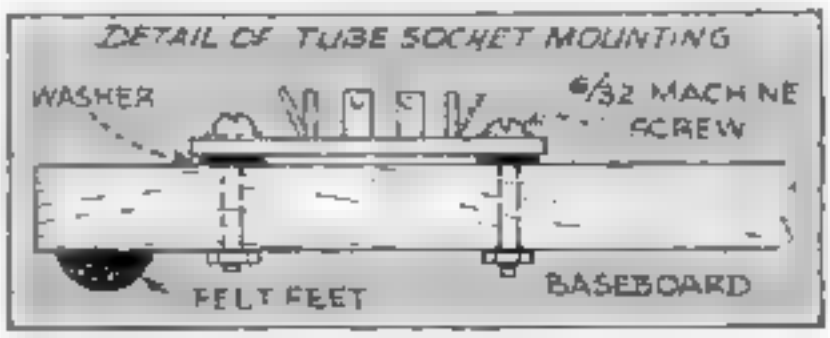
Wooden baseboard, 6"x12".
Composition panel, 5"x7".
Toggle switches (2), D.P.-D.T. and S.P.S.T.
Practice key
Potentiometer, 25,000-50,000 ohms.
Audio transformer, any type, any ratio.
Six-prong plug-in coil.
Six-prong coil base.
Eight-prong octal socket.
Triode amplifier tube, 1G4-GT/G.
Tuning condenser, .00014 mfd.
Mica condensers (2), .0001 mfd. to .0005 mfd. and .0004 mfd. to .0005 mfd.
Carbon resistor, ½ watt, 2 to 5 megohms.
RF choke (optional), 2.5 to 8 millihenrys.

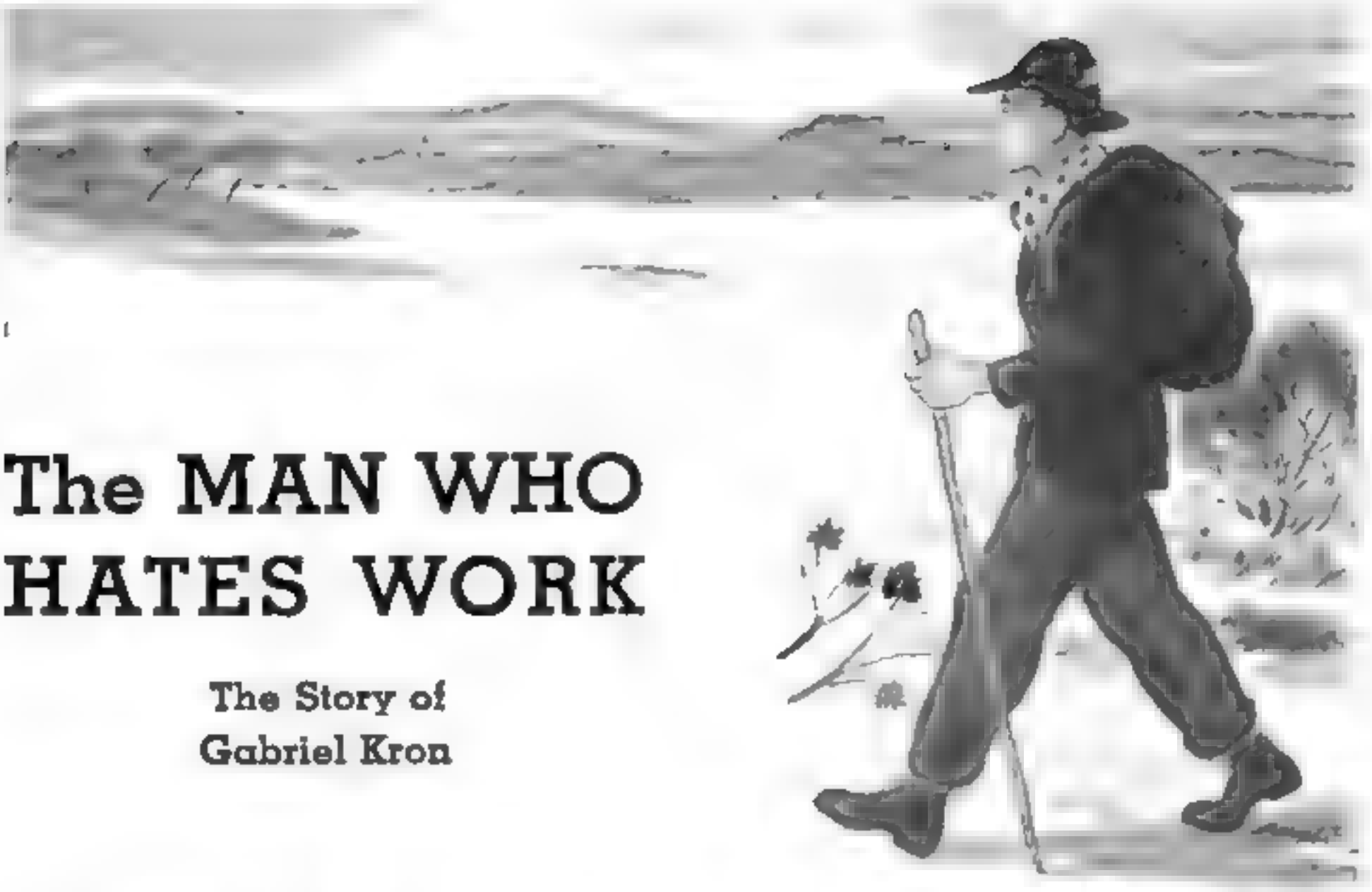
tuning condenser with a 2¾" dial and pointer, a 25,000-ohm regeneration control, and two toggle switches. One of these switches is of the double-pole, double-throw type and changes the circuit over for use either as a radio receiver or a code-practice oscillator. The other is an ordinary single-pole, single-throw switch and cuts off the filament supply whenever the unit is not being used.

The sending key and radio-oscillator unit are both mounted on the base. The latter unit includes a six-prong plug-in coil, octal wafer socket, and audio transformer. Connections to phones and batteries are made by means of Fahnstock clips arranged along the back of the baseboard.

For the audio transformer, take one out of the junk box, if possible, because the older it is the better it will work as an oscillator. A new audio transformer has too much inductance for this purpose, making it impossible to obtain a high-pitched note. If no oscillation is obtained when the oscillator is tested, reverse the leads to the primary of the transformer. It is important that correct polarity be observed. If desired, the pitch of the tone may be varied by placing a fixed condenser across the secondary of the audio transformer, using one of from .02-mfd. to .002-mfd. capacity. The higher the capacity (.02 mfd.) the lower the pitch will be.

When the instrument is used as a radio receiver, the plate supply ("B" battery) is usually about 45 volts, but when it is used as a code oscillator, the plate supply must be reduced to 4½ volts. An ordinary 4½-volt "C" battery will do for this purpose. In either case, whether the instrument is used for reception or for code practice, the filament voltage remains the same—1½ volts.





The MAN WHO HATES WORK

The Story of Gabriel Kron

GABRIEL KRON hates work. In fact, he's worked for years to find ways of eliminating work.

It's not that he's lazy—he's been working ever since he was 10. He's done everything from washing dishes and peddling necktties to digging ditches and bottling vinegar.

Gabe was broke when he came to America, but he wanted a college education more than anything in the world. So he really had to work.

And Gabe did, for he was a determined young man. (Once he made up his mind to learn English, and he never stopped until he had memorized a whole dictionary!)

After seven months of hard work, Gabe had exactly $5 over and above one year's tuition. So he had to work all the way through college.

With his diploma safely in his hands, he decided he'd worked about enough. But he worked another month to earn an automobile; then he started

on a tour of the world.

The car collapsed in Death Valley, and Gabe *walked* the rest of the way.

He did a great deal of thinking as he hiked along. For one thing, he figured out how to eliminate a lot of work by applying some very highbrow mathematics to some very practical engineering problems.

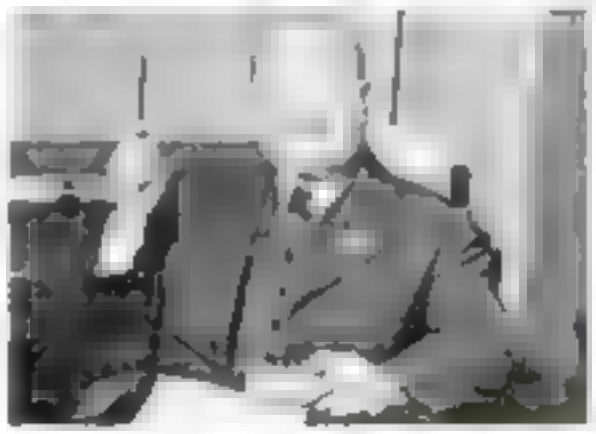
On and on he walked—thinking, sleeping in jails and treetops, hitching rides on elephants and tramp steamers.

Eventually he strolled into the little Hungarian village he had left eight years before when he had gone to America. The home-town folks were disappointed. Other people came back rich; Gabe had acquired only mosquito bites!

G-E engineers became interested in Gabe when they read one of his engineering reports. Then they heard him talk about his ideas and were so impressed they hired him.

Since then the whole world has become interested in Gabe and his work-saving ideas, for in 1936 he received an international award for making a great contribution to electrical engineering.

And he's still working—still looking for ways to eliminate work.



Maybe someday *you* will join Gabriel Kron and the men who, like him, are searching restlessly for the better way. Gabe will tell you that it's hard work—but that's the one kind of work he loves. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

Nickels Without Nickel

(Continued from page 87)

for the highly skilled technicians who intently cut away, chip at, and weigh with hairbreadth accuracy the metals which go into the formula-prescribed separate lots, or "melts," which are made into the various alloys used in coining. The composition of the alloy used in making the nickel-less nickel is 56 percent copper, 35 percent silver, and nine percent manganese.

After the lots have been made up in their proper proportions they are taken to the melting room, melted in 1,750-degree electric furnaces, cast into 52-pound ingots, and annealed by immersion in cold water to soften the metal. These half-inch-thick slabs are then passed through a series of breakdown and finishing rollers, at the completion of which they are long strips of dark-colored metal the exact thickness of a five-cent piece and wide enough for three coins to be punched out of them.

These strips are fed into blanking machines which punch coin blanks out of them at the rate of 900 a minute. The metal remaining in the perforated strips is remelted and again cast into ingots.

Smooth metal disks the exact diameter and thickness of a nickel, are fed into an upsetting machine which raises the edge, or "collar," that appears around the circumference of all finished coins. Next they are taken to the annealing room, where they are softened again by being heated and plunged into cold water. Then they are cleaned in a revolving drum containing acid, and are ready for coining.

The electrically operated automatic coining machines are of special design and are built in the Philadelphia Mint. The blanks are poured into a feeding funnel at the top of the machine. As each one drops through a cylinder it is grasped by the fingerlike pincers of a moving arm and held firmly while obverse and reverse dies are simultaneously driven downward and upward on it with such tremendous force that the metal of the blank flows into every minute depression of the dies. As the completed coin drops into a receptacle at the bottom of the machine the pincers grasp another blank and the process is repeated.

The new coins are inspected for imperfections and are then taken to the counting room and counted at the rate of 4,000 a minute by a machine which also bags them —and then ties up the bags. Nickels are packed for shipment in bags of 1,000 which weigh a little under 13¼ pounds.

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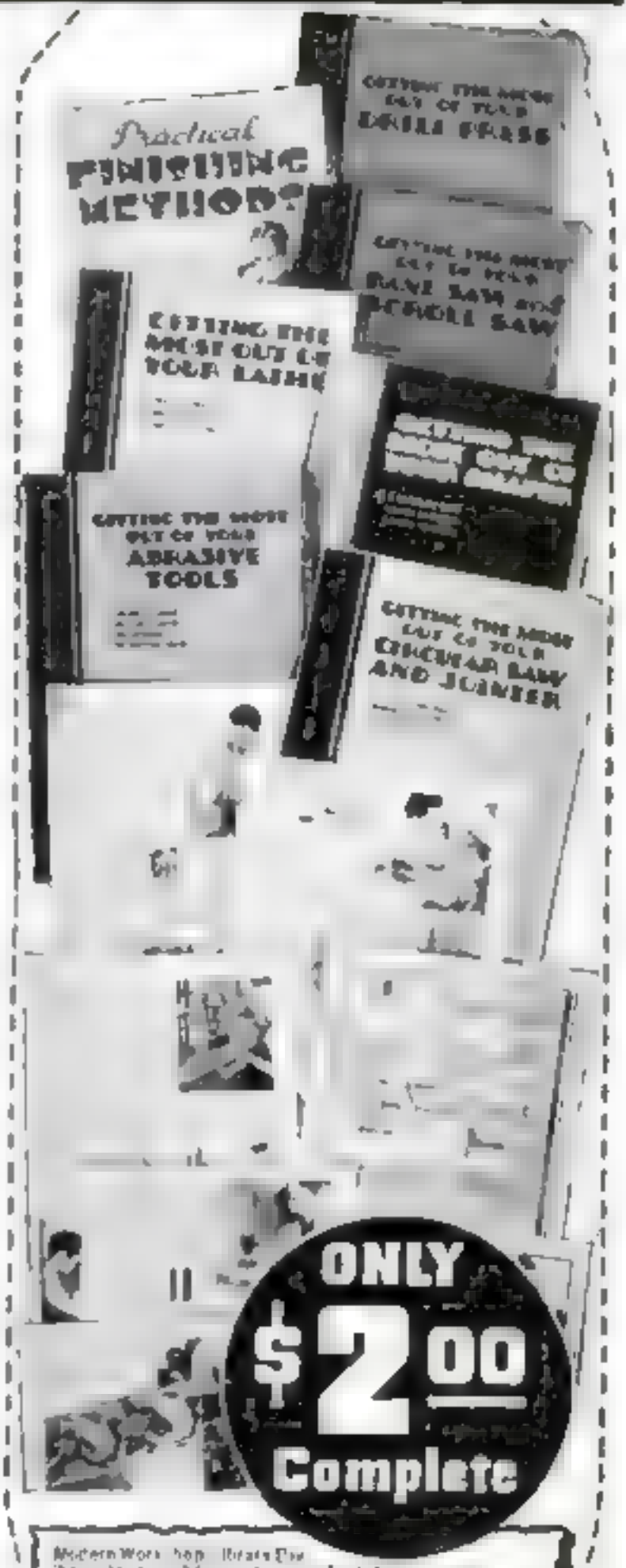

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Band Saw & Scroll Saw—Ripping and Resawing, Use of Standard Fence; The Ripping Blade, Ripping Curves, Tilt Table Operations, Cutting off with Fence and Gage; Use of Stop Rod; Cutoff Block, Using Clamp attachment, Crosscutting Wide Stock—Cutting Circles Jig Construction Cutting Glue Blocks Round Corners, Circular Rails; Sanding; Compound Band Sawing; the Cabriole Leg; Compound-Sawed Turnings Ornamental Work, Sawing in Multiple; Ripping Thick Stock, Split Dowels; Tapering Jigs; Marking Turning Squares; Pattern Sawing Beveled Curves Metal Cutting Scroll Saw Operations, Sanding and Inlay.

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[illegible] Tools—Buffer, Belt and Disk sander attachments—Explanation of Different Abrasives How to Sharpen Tools, Grinding Shaper Cutters, Grinding Twist Drills, How to Use Sanding Drums, Cut-Off Wheels.

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Blueprint for Invasion

(Continued from page 96)

some of the multiple raids may be only demonstrations or feints, but the enemy will have the pleasure of deciding in each instance whether that particular assault is or is not the spearhead of a full-scale invasion. For every one that seems at all menacing he will have to set his transportation system in motion to bring up supplies and reinforcements, and use up valuable rolling stock to redistribute his forces. In the meantime the bombers will be busy overhead, plastering communication lines and airports, and the parachutists will be raising hell in their own fashion. The enemy will need a great deal of matériel and large forces in many places at once, and if they run out of reserves at any one point they will face disaster. Once a major break-through occurs, penetrations and envelopments will follow over a wide front. Those strongholds that still hold out will be isolated and dealt with at the invaders' own convenience.

The losses of the attackers in the early stages will be huge. At Dieppe the Allied division which was engaged lost about half its effectives, in spite of excellent air support. The forces which make the first landings must expect to sustain losses of this magnitude. With all the reconnaissance, diversionary moves, feints, and harassments that can be inflicted on the enemy, the principal penetrations will just have to be bulled through. In some of their landings, when they encountered strong opposition, the Japs accepted heavy initial losses with equanimity. Americans will certainly not be outdone in this respect.

In all likelihood, the attacking general staffs will have a pretty good idea of where the major break-through will occur, and their reserves will be disposed accordingly. But they will have to be prepared to change their plans at a moment's notice. Much also will depend on the subordinate commanders. No two landings are alike and the ability of the attacking troops to adapt themselves to conditions quickly and intelligently is just as important as good staff work and planning. Landings are always fast-moving situations, and only dynamic leadership on the spot can seize opportunities as they arise and utilize gains to get more gains. And all possible contingencies will have to be provided for. It is perfectly possible, for example, that when the Axis forces are in a desperate position they will resort to the use of gas wherever wind conditions permit.

Nor, when we capture a harbor which will

(Continued on page 226)

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KEUFFEL & ESSER CO., Hoboken, New Jersey

Blueprint for Invasion

(Continued from page 224)

serve in this war as St. Nazaire served in the First World War, can we expect to receive it intact with the compliments of the former occupants. They will wreck it as completely as they can before they evacuate, and they will be in a position to do a thorough job. About all we can expect to get is land, water, and debris. But that will be enough. The Army's engineer units, and the special Navy construction detachments, known as Seabees, will rebuild what has been destroyed, and add a lot more.

When we have an adequate harbor, the initial stages of major operations on the Continent will be over. The logistical problems accompanying such operations will then be possible of solution by known methods. This harbor (or, more likely, harbors) will be the eastern terminus of a pipeline which will carry the products of American war industry to Europe. The Germans will do their utmost to break the line along its entire length, and particularly to block its outlet. It is only prudent to assume that they will fight as furiously when they are on the road to defeat as when they seemed to be headed for victory. This outlet will therefore need the strongest air defenses that modern military technology can devise, for whatever air power the Germans still possess will be flung against it. It will have to be guarded against submarine and surface attack by nets, booms, and mines. The batteries with which the Germans have ringed the European coast will have to be duplicated here. Around the invasion area there will be such a concentration of airfields, AA and coastal artillery, submarines and anti-submarine devices, large and small naval surface craft, merchant ships, transports, tugs, docks, warehouses, unloading and forwarding facilities, barracks, troops of all arms and services, as the world perhaps has never before seen. But once the machinery of this gigantic enterprise is in motion the push into Germany will be in full progress.

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Medical Soldiers

(Continued from page 133)

tion and aptitude as determined by classification tests. The schools have a combined yearly capacity of about 160,000 trainees—35,650 basically trained medical soldiers can be delivered to medical units or installations every 10 weeks.

Medical transportation is a vital factor, not only in saving the lives of sick and wounded men, but in maintaining the morale of the whole Army. Once a unit gets into action, good morale implies the individual soldier's willingness to die to gain a vital objective. But the soldier knows that he may neither escape unscathed nor be killed; he may be wounded. In that case he wants to be taken out of there—fast. If he has confidence in the Medical Department's ability to move him with the least possible delay, and to give him every possible chance for life, he will be a better fighting man.

The ideal ambulance will go almost anywhere, provide a comfortable ride for the patient, and go as fast as is consistent with safety. The latest Army motor ambulances fill these specifications adequately and are cheap to build. The body is mounted on a standard Army half-ton chassis with four-wheel drive. The gross weight with a 1,500-pound "payload" is 6,670 pounds, and the speed is anything from 2½ to 55 m.p.h. on roads. The vehicle can go cross-country if the terrain is not too rough. The body is of 20-gauge steel, thermally insulated, and hot water from the engine maintains a 70-degree temperature when the outside temperature is below zero. A fan changes the air in the body once a minute. Rear doors are 58 inches wide and 47 inches high to facilitate loading. The springs are inclosed in metal covers to prevent rusting. An ambulance of this type will accommodate four litter patients or seven sitting patients. The jeep offers excellent possibilities in forward areas as an ambulance with very slight adjustments.

The Army also has a very light horse or mule-drawn ambulance (1,130 pounds) with an automobile body and low-pressure tires. This will hold four men in litters or five seated. At the other extreme there is an ambulance of bus type, holding 12 litter patients or 20 sitting patients. This is equipped with front-wheel drive for speeds of 2½ to 70 m.p.h., and although designed for roads can go cross-country when necessary. Plans have also been made for converting ordinary busses into ambulances if required. It is

(Continued on page 230)

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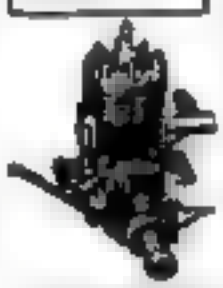

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(Continued from page 228)

possible that future ambulances will be lightly armored for protection against small-arms fire.

Air ambulances will be used by the Army as far as possible. The War Department recently announced the formation of an Air Evacuation Group (Medical) to evacuate sick and wounded soldiers at top speed. It is estimated that a trip which might take 18 hours over difficult terrain in a vehicular ambulance can be accomplished in one hour by plane. The planes to be used are large transport or cargo ships which will bring in supplies and take out the wounded. They will be fitted with racks for standard Army stretchers, surgical and blood-transfusion facilities, oxygen masks, heating pads, and other equipment for 40 patients. Each plane will carry a flight surgeon, a nurse, and a Medical Department enlisted man who has been specially trained for evacuation of wounded by air.

To do his best the physician or surgeon needs adequate laboratory and operating facilities. In war the surgery and the laboratory have to go to the patient, not the other way around. To design and build a rolling surgical hospital, with its own water and power supply and facilities for heating, ventilation, sterilization, and all the other requirements, is a problem which at first seems insoluble. But the Army has developed such hospitals in both self-propelled and semitrailer types.

The methods of treatment used in the Army's mobile and fixed surgical hospitals are the latest and best. The sulfa drugs occupy a prominent place in military surgery these days, and the mortality figures leave no doubt as to their efficacy. In World War I the mortality from perforating wounds of the abdomen was 80 percent. The victim had one chance in five to live. Now, on the basis of experience in the Philippines and at Pearl Harbor, Maj. Gen. James C. Magee, Surgeon General of the U. S. Army, reports that such wounds are seldom fatal, and a large number of the men who sustained serious wounds have already returned to duty.

The sulfa drugs are a vital element in the remarkable results that Army surgeons are getting in wound therapy, but only one ele-

Last we may consider what the Medical Department puts first—the *prevention* of disease. The air lines talk about preventive maintenance. They got the term from preventive medicine. In every war the enemy most to be dreaded is disease. Disease kills more men than wounds. The health of the Army so far has been excellent. This is not mere luck; if it were we could not rely on its continuance.—CARL DREHER.

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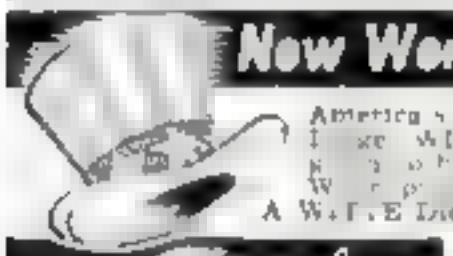

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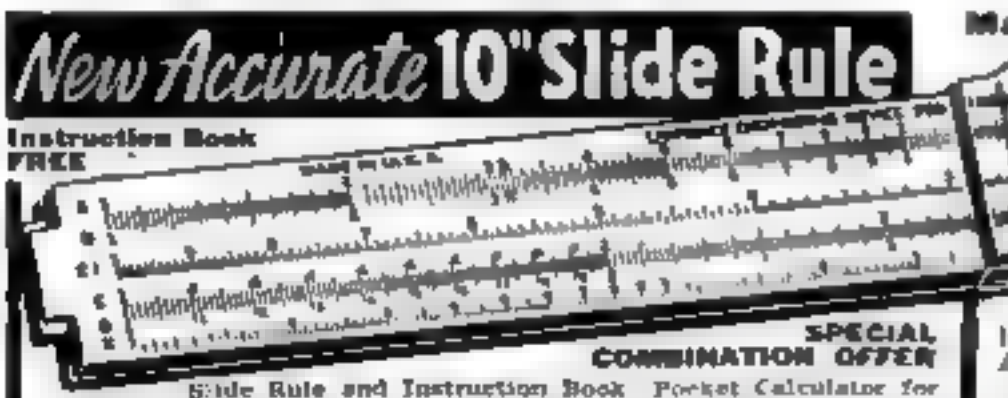

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Six-Months Miracle

(Continued from page 103)

to the successful prosecution of the war.

For some time past, a good gravel road called the Richardson Highway has linked Fairbanks with the important port of Valdez. Military authorities have urged the strategic value of a highway link between this point and the port of Anchorage, due north of Seward at the head of Cook Inlet. Now, simultaneously with the opening of the Alcan Highway, the Army announces secret completion of Glenn Highway, a route between Anchorage and Valdez via the Richardson Highway. A branch of the Alcan Highway connects at Gulkana.

And that is not all. On the twisting and turning Alaska Railway that passes through Anchorage on its way between Seward and Fairbanks, tunnel crews have just finished driving a 13,000-foot-long bore beneath a glacier-covered mountain. Fourth longest tunnel in the country, the cut-off saves a haul of 60 miles—and, still more significant, renders a previously exposed part of the Alaska Railway invulnerable to enemy attack.

Both these projects, and others immediately under way, tie in the Alcan Highway with the rapid development of Alaska's rail-and-road network. Already crews of engineers with dog teams have braved winter cold to survey what the Army considers the most important needs of Alaskan transportation now pending. These include:

A railroad leading from Fairbanks to the Bering Sea, which washes Alaska's western coast.

Development of the Alaskan port of Skagway, far to the south.

Double-tracking the present short-line railway, now leased by the Army, between Skagway and Whitehorse.

Finally, using this pioneer link in the future railway planned between Prince George and Fairbanks.

While military considerations now are paramount, eventually the Alcan Highway and its connections are expected to lead to the development of vast mineral and agricultural sources of the North Country. Vast coal and oil deposits of Alaska and Canada, too inaccessible to be of value, will become available. Prairie lands offer untouched possibilities for farming. And known Alaskan deposits of such critical war materials as nickel, tin, tungsten, chromite, and quicksilver—largely undeveloped for lack of transportation—will add to the resources of the United States.—ALDEN P. ARMAGNAC.

Our Navy Strikes from the Sky

(Continued from page 76)

tator, the first monoplane ever to be operated from a carrier. Developed from the Douglas XT3D-1, it went into service in 1936 and has served, unmodified and unchanged, until its duties were taken over by the newer Grumman TBF or Avenger.

Of all carrier jobs, this is admittedly the toughest kind of flying. Even on deck, before take-off, its 50-foot wing is folded back, and the pilot has to taxi into line by forward signals from the yellow-shirted traffic man. He must unfold his wings as he goes, minimizing the time loss between ship take-offs. Having to haul the greatest load the greatest distance, the TB usually is the lightest armed of the three general classes. The fighter has its maneuverability and its armament to keep it safe, the dive bomber has enough guns to keep it out of trouble and can, if necessary, outdive the attacker. The torpedo bomber, however, is a sitting duck in the average set of approaches and requires, for the most part, fighter escort.

The Devastator served a longer useful career than any single fighting design in the Air navy's history. While she will probably still be seen around for many months to come, the Coral Sea action indicated the need for a ship that would not require quite such close attendance on the part of the fighters. The Navy needed a more versatile major air vehicle for the carriers. The result was the TBF, the Grumman Avenger. The Avenger bears a strong family resemblance to the Wildcat, and a lot of the clawing F4F's characteristics remain. The Avenger carries the 21-inch Bliss-Leavitt torpedo internally rather than semiexposed as in the Devastator.

The Avenger's total armament is close to that of a fighter, although not concentrated in one place for maximum effectiveness. It is not designed to look for combat. However, with guns forward, in the turret, and through the belly, it is a nasty customer to tackle. Unlike the TBD, the Grumman can be used to lay depth charges or carry a load of bombs well above 20,000 feet.

This is the current stock for the carriers. As for shore-based planes, the Navy is operating several types of long-range land planes. Prominent among these is the PB4Y, the Consolidated B-24 four-engined bomber known as the Liberator. The Lockheed Ventura, designed to take up where the famed Hudson left off, was borrowed from the English to become the PBO. The B-17, the Boeing Flying Fortress, will appear

(Continued on page 235)

Our Navy Strikes from the Sky

(Continued from page 233)

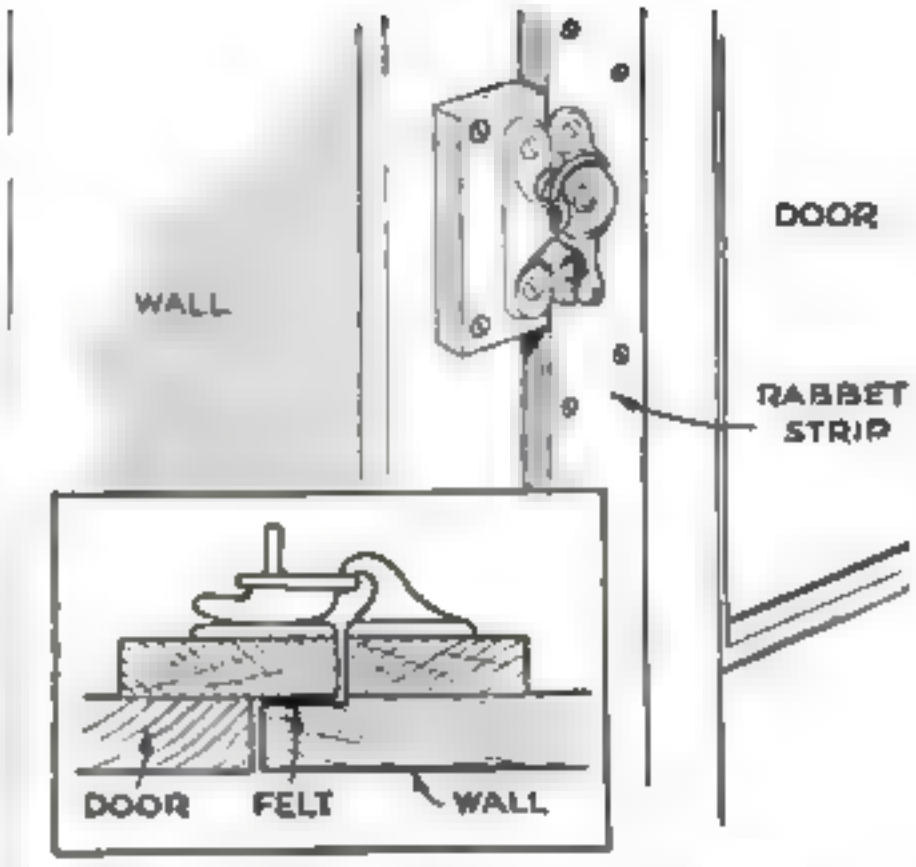
shortly in Navy stripes. In actual warfare, many basic weaknesses were discovered in the operation of large flying boats. The main shortcoming was the fact that no flying boat could be equipped with a gun emplacement in the bottom. More than a third of the hull surface is totally blind area.

The remainder of the PB series is invested in the traditional flying boats, currently the PBY or twin-engined Catalina boat; the PB2Y, its big brother, the four-engined Coronado; and the PBM, the Martin Mariner. This type has been designed primarily for long-range overseas scouting, accommodating crews of between seven and 15 men. They are capable of remaining in the air over long periods regardless of the vagaries of the weather. When used as bombers, they must be capable of getting out of the water with large loads of bombs, depth charges, or torpedoes and must carry enough defensive armament to compensate for their relative slowness.

The flying boat has many operational advantages. Any sheltered strip of water is a base for a seaplane. In ordinary weather, a seaplane tender, a small, inexpensive ship, can service it and keep it going even at sea. Furthermore, the development of remote-control firing positions now under investigation may reduce the blind-spot objection

Now that the pattern of sea-air warfare has been established, modifications in naval-plane design must be made accordingly. Although it has been a close fight, one major portion of the victory is already ours. This is the battle of design philosophy.

Japan planned for a quick victory at sea. She planned to pay for it by sacrificing pilot and air-crew safety for a small percentage of climbing and turning ability. Japan's engine development lagged behind ours. The largest power plant she has exhibited this far is about 1,250 horsepower. To achieve performance with these smaller engines, she had to pare down size and weight. The result was the Misubishi Zero and her series of dive and torpedo bombers. Light and unarmored, these ships disintegrated under fire. The newer series of Jap fighters indicate a trend toward armor and self-sealing tanks. Not that Japan has acquired any more respect for human life, but that the pilot losses have been greater than she could afford for the amount of air control she thus far has gained. This means that Japan must scrap a lot of her research, alter production, and plug the gap with makeshifts. Changing her mind is going to cost her the war.



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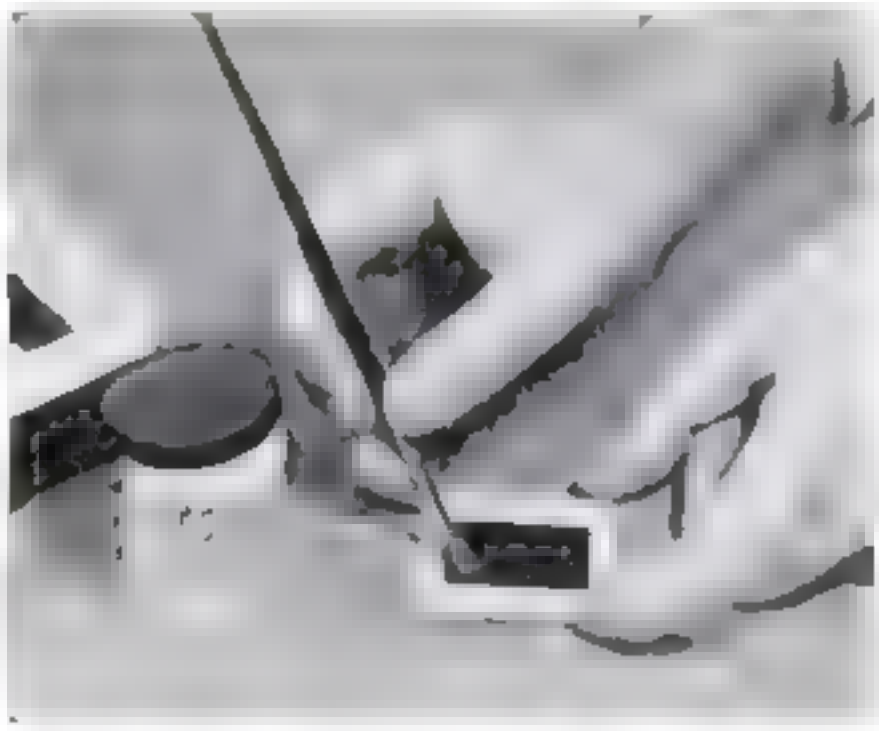

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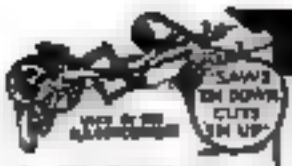

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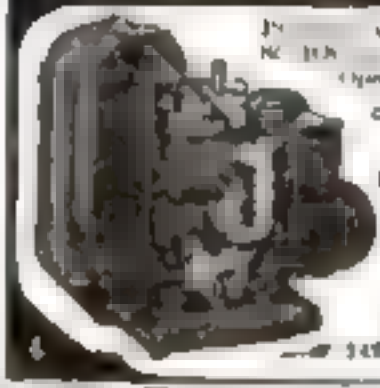

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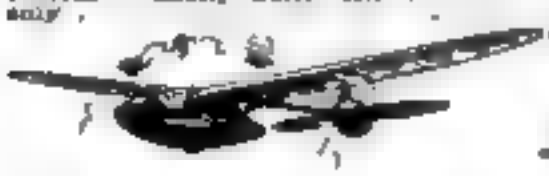

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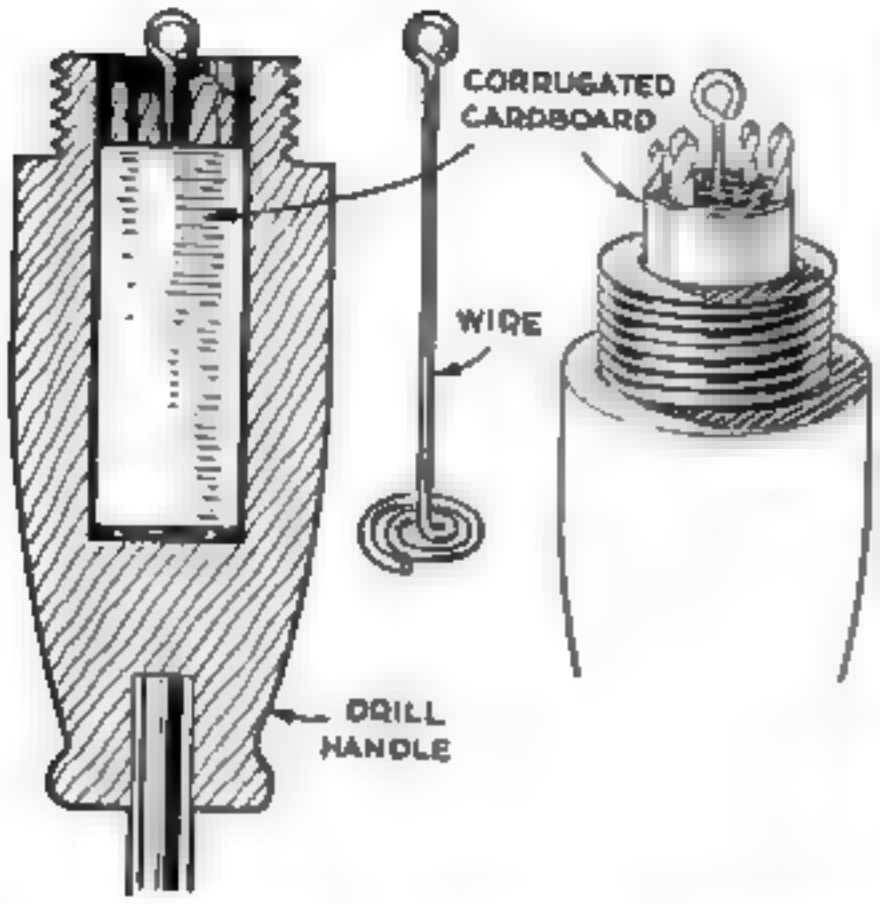
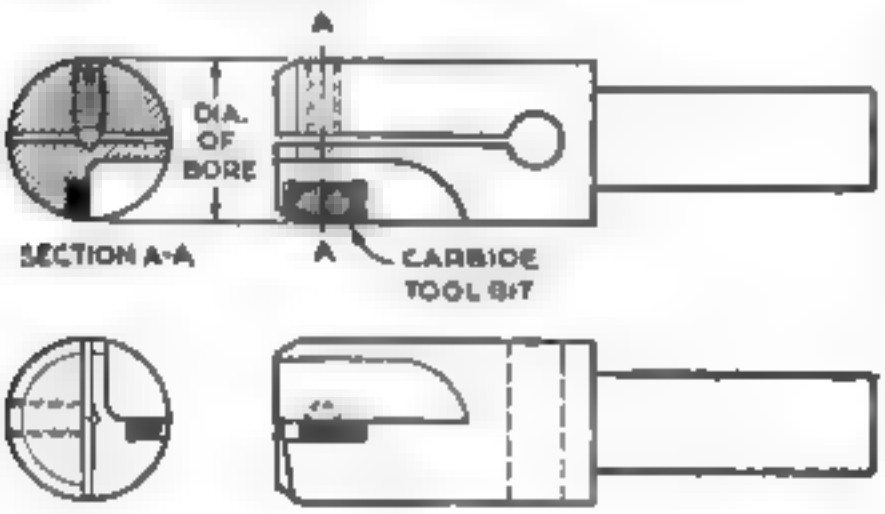


Corrugated Cardboard Holder Keeps Drills Separated

Most hand drills have a hollow handle to accommodate a set of small bits. Although this is a handy place for them, they may become dull from striking against each other. To prevent this, roll up a piece of corrugated cardboard to fit into the handle, and slip the drills into the corrugations. A piece of wire shaped as shown and inserted in the roll makes it easy to pull out the holder.—Ronald Eyrich.



Shopmade Carbide-Tipped Tool Bores Cored Holes to Size

Subcontractors and other shop owners doing production work will find the shopmade tool shown above very useful for precision boring of cored holes in castings. The body of the tool may be made of cold-rolled steel and casehardened. An expansion slot and a screw permit adjustment for wear and sharpening of the carbide tip, which is brazed on in the usual way. The shank is turned to fit into the tailstock ram, turret head, or other tool-holding device that is to be used.—U. G. Densten.

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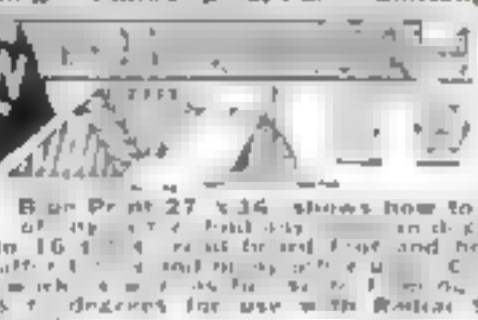

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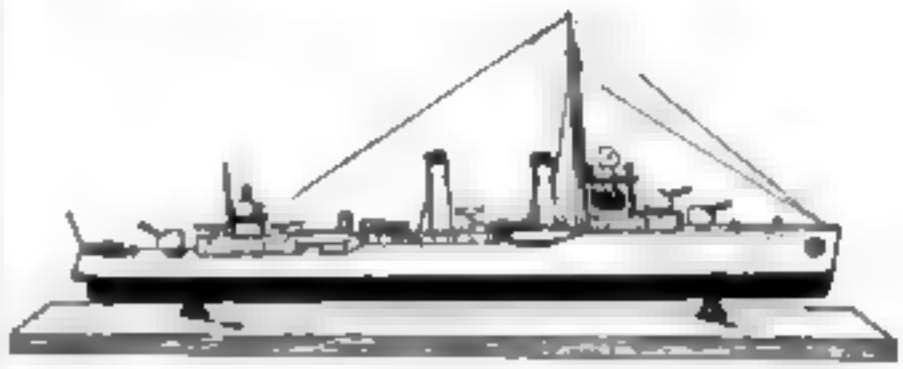

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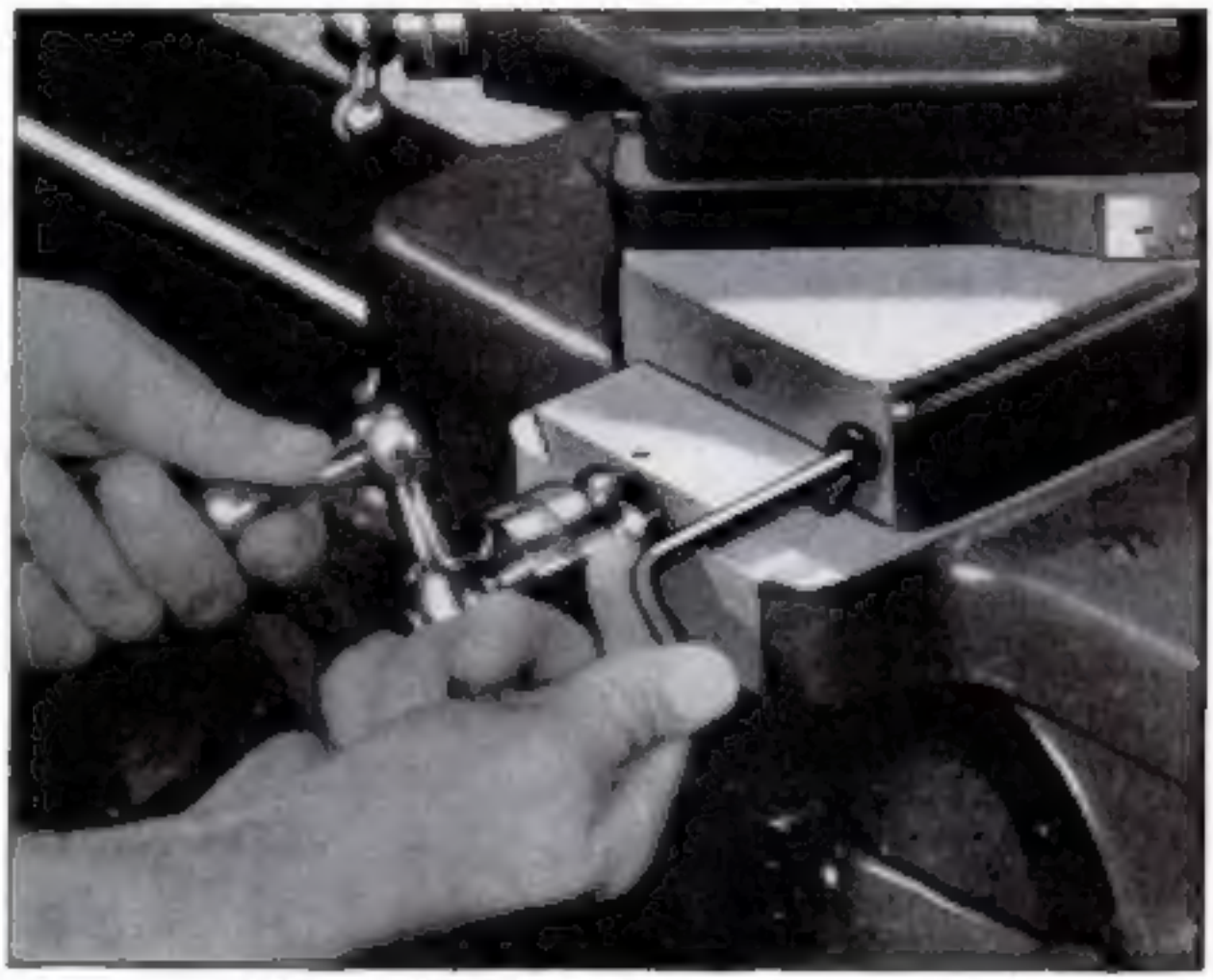
HOW TO GET THE MOST OUT OF YOUR LATHES

No. 4 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

Keep Your Lathes in Trim

The old proverb, "An ounce of prevention is worth a pound of cure", is as applicable today as when first expressed by some long forgotten sage. Lathes and other modern precision tools must be "kept in trim" if they are to give the long, trouble-free service that is expected of them.

Although the adjustments required to "keep the lathe in trim" are few and simple, they are important and should not be neglected. And even though the lathe is rigidly constructed and will stand some rough handling, it should be protected from unnecessary abuse.



Adjust the dovetail gibs to insure accurate work

Power Transmission

Maximum efficiency as well as maximum production depends on the effective transmission of power to the lathe spindle. The motor, being the source of power for the lathe, should develop its full rated power and should operate at a uniform speed. If for any reason the line voltage drops below the rating for which the motor is constructed, the motor will not deliver full power. For this reason the current should be checked at the motor occasionally and the correct line voltage maintained.

To transmit the power from the motor to the lathe spindle efficiently, all belts must be properly adjusted. If the belts are too loose they will slip, and if they are too tight they will cause loss of power through friction. The belts should be just tight enough to transmit the required power without slipping. Precision belt tension adjustments provided on South Bend Lathes make it easy to keep the motor V-belts and flat cone pulley belts properly adjusted.

Dovetail Slide

All dovetail slides on South Bend Lathes are equipped with gibs which may be adjusted to eliminate play. When the adjustment of the dovetail gibs is neglected, looseness of the slides may cause the tool to chatter or may result in inaccurate work.

The gibs should be tight enough to assure the necessary rigidity, but not tight enough to bind and make the dovetail slides hard to operate.

Tailstock Adjustment

The alignment of the tailstock top should be checked frequently as any misalignment will cause the lathe to turn a taper. To test alignment, place a bar of steel, 1 inch or larger in diameter, between centers and machine two collars of equal diameter not less than 4 inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. Any difference in the diameters indicates misalignment. Correct the alignment by turning the tailstock top set-over screws until both collars can be turned to the same diameter.

Don't Abuse the Lathe

Just because the lathe is made of iron and steel is no reason to expect it to stand abuse. Never use the lathe bed as an anvil. Don't use a crowbar to straighten a shaft between the lathe centers. Never rap chips out of a file by striking it on the lathe bed or tailstock.

Write for Bulletin H4

Bulletin H4 giving more detailed information on keeping the lathe in trim will be supplied on request. Also reprints of this and other* advertisements and bulletins in this series. State quantity wanted.

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